

Architectural Transitions in the Pottery Neolithic

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Abstract

The archaeological assemblages of the Levantine Neolithic changed dramatically from the Pre-Pottery Neolithic to the Pottery Neolithic. The Pre-Pottery Neolithic inhabitants produced well-planned, well-built, well-maintained architecture on a consistent basis, both within sites and across the region. In contrast, the architecture at Pottery Neolithic settlements exhibited a variety of forms ranging from pit dwellings, to round, rectangular, and apsidal buildings, to courtyard buildings, to no architecture at all.

The end of the Pre-Pottery Neolithic coincided with a global climatic event, the 8.2 ka cold event, a 300-400 year dip in global temperatures, accompanied by increased aridity. The drop in temperature likely changed the environmental conditions in the Levant, affecting the economic systems of the inhabitants. Late Pre-Pottery Neolithic inhabitants no longer relied on hunting for their primary meat source, as domesticated goat quickly became the dominant faunal assemblage at late Pre-Pottery Neolithic sites. This thesis argues that the lack of cohesion observed in the Pottery Neolithic archaeological assemblages is a reflection of the different responses and adaptive strategies used by different settlements to cope with the change in environmental conditions.

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List of Abbreviations

GISP2	Greenland Ice Sheet Project II
ka	kiloyear
kyr	one thousand years
LIS	Laurentide Ice Sheet
NGRIP	North Greenland Ice Core Project
PPN	Pre-Pottery Neolithic
PPNA	Pre-Pottery Neolithic A
PPNB	Pre-Pottery Neolithic B
MPPNB	Middle Pre-Pottery Neolithic B
LPPNB	Late Pre-Pottery Neolithic B
PPNC	Pre-Pottery Neolithic C
PN	Pottery Neolithic
PNA	Pottery Neolithic A
PNB	Pottery Neolithic B
SST	Sea Surface Temperature
THC	Thermohaline Circulation

Chapter 1: Background Information

1.1. Introduction

There is no universally accepted understanding of the cultures that represent the Pottery Neolithic Period in the southern Levant. With no agreed-upon way of classifying cultures, a linear timeline is useful when observing changes within and between sites. In the Southern Levant, the Pre-Pottery Neolithic is divided into two phases, the Pre-Pottery Neolithic A (PPNA) 8500-7500 B.C. and B (PPNB) 7500-6000 B.C. The end of the PPNB saw a widespread desertion of many settlements (Mellaart 1975:68). Following the PPNB, an intermediate phase, the Pre-Pottery Neolithic C (PPNC) 6000-5500 B.C. was first identified at 'Ain Ghazal (Simmons et al. 1988) and soon after at Wadi Shu'eib (Simmons et al. 2001). The PPNC is currently dated from 6100-5600 B.C. Prior to the identification of the PPNC, the prevailing theory was that the Southern Levant was abandoned by populations moving north and east until settlements were re-established with new technological advancements. The new culture was the Pottery Neolithic (Mellaart 1975:68-69). The identification of the PPNC at 'Ain Ghazal indicates continuity from the PPNB to the PPNC to the PN (Gopher 1995:207). To early scholars the emergence of the ceramic industry in the PN appeared to be sudden and was attributed to outside sources, but by the 1990s the general consensus became that the Neolithic peoples of the Southern Levant developed pottery on their own (Banning 1998:206).

Chronologies in the southern Levant are built upon the archaeological work at Jericho— a large, well published site, which is then used as a comparison for other sites (please refer to Figure 1.1 for a map of all sites examined in this study). Thus Jericho is the Neolithic type site, “a place...that gives its name to a culture, cultural period...because it provided the first recognized, best studied, or most representative example” (Darvill 2002). A relative and, if possible, absolute chronology is established for a site; then the archaeological assemblages associated with each chronological stage are used as comparative material for other sites. Jericho became a type site for the Levantine Neolithic, as it was one of the first Neolithic sites to be excavated and published, with multiple chronological occupations identified. Jericho was first excavated by Garstang in the 1930s. Then in the 1950s, it was re-excavated on a large scale by

Kenyon. As time passed, Jericho became a type site because it was well published and excavators of other sites used the Jericho assemblage as analogous for their own assemblages.

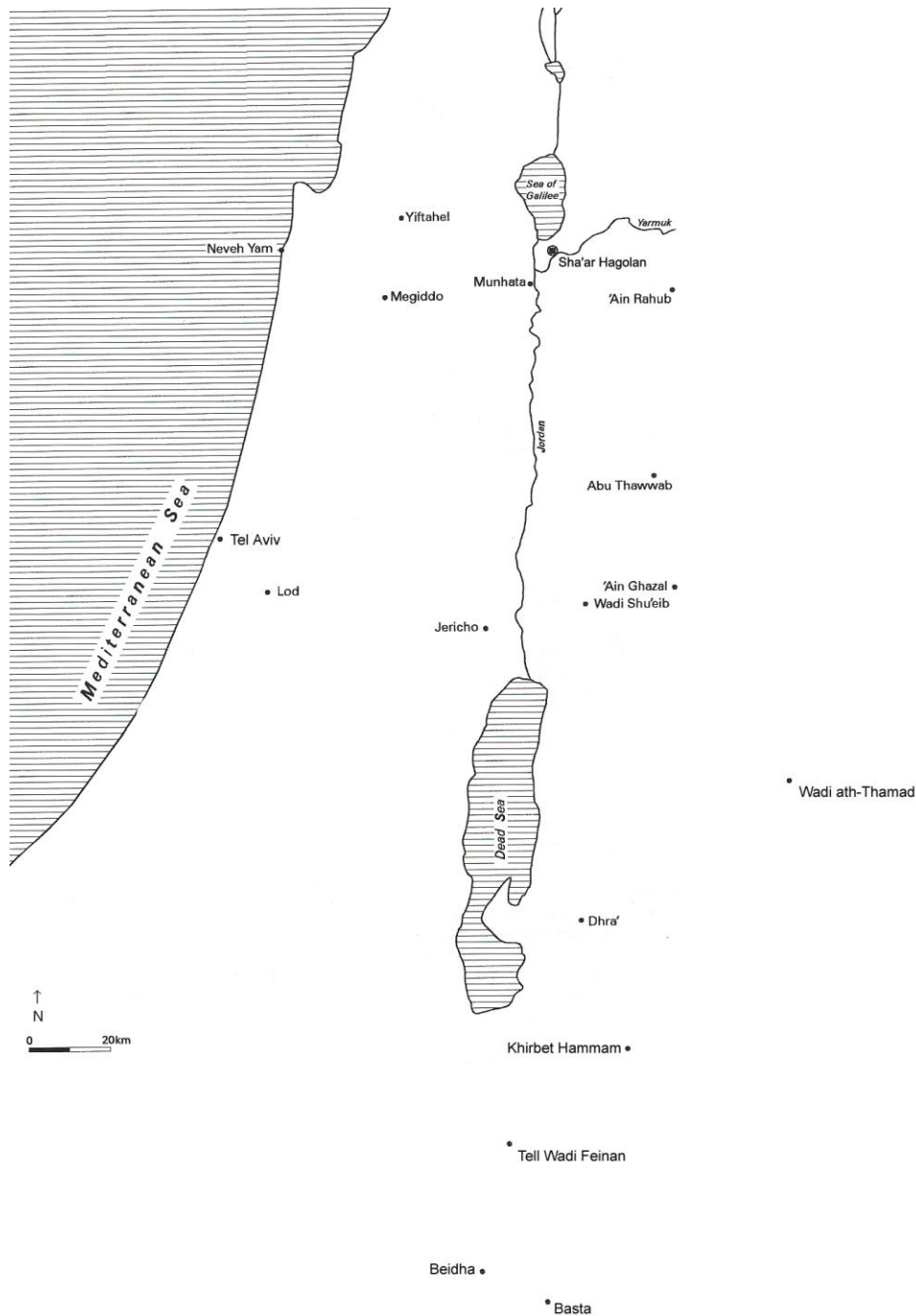


Figure 1.1: Map of Near Eastern sites. (Garfinkel and Miller 2002a:2) Reprinted with permission.

At Jericho, Garstang et al. (1936) identified 17 levels of occupation: Layers I-VII as Early Bronze Age, Layers VIII and IX as Neolithic with pottery, and Layers X-XVII as Neolithic containing no pottery. When Kenyon (1957) re-excavated Jericho she identified two pre-pottery Neolithic phases, followed by a gap in occupation, then two pottery Neolithic phases. Kenyon proposed that the beginning of the Pre-Pottery Neolithic A (PPNA) was prior to 8000 B.C. There are a few carbon-14 dates of unknown calibration, ranging from 7825 B.C. \pm 110 to 6850 B.C. \pm 210 taken from an occupation layer attributed to the PPNA (Kenyon 1985:26). One of the distinctive features of PPNA construction was the use of the hog-back mudbricks defined by Kenyon as “an elongated oval, the base flat and the upper surface curved or hog-backed” (Kenyon 1957:70). Mellaart (1975) dates PPNA Jericho from 8350 – 7350 B.C. on the basis of radiocarbon samples.

The PPNB Jericho occupation is separated from the PPNA by a layer of erosional material representing an unknown duration (Kenyon 1957:70). Kenyon (1957; 1985) identified the PPNB occupation as that of an entirely new people, the plaster-floor people, who she argues arrived with an advanced knowledge of architectural techniques and remained at the site for at least one thousand years (Kenyon 1985:31). The application of plaster to walls and floors is considered typical of the PPNB. Late within the Jericho PPNB stratum are two ^{14}C dates (of unknown calibration), 6250 B.C. and 5850 B.C. (Kenyon 1957:74). If the PPNB occupation was one thousand years then the PPNB began within the 7th millennium B. C. (Kenyon 1957:74). Kenyon (1957) initially stated that the end of the PPNB is around 5000 B.C., but in later publications (1985) the date given is 6000 B.C., on the basis of comparative material from excavation of other PPNB sites. As other PPNB sites were excavated and ^{14}C dated, the archaeological collections were compared with each other and with Jericho, refining the chronological timeline.

Following the PPNB, Jericho was abandoned for a short time. The exact length of the time lapse between the PPNB and the next period, the Pottery Neolithic (PN) is unknown (Kenyon 1985:43). The occupation period following the PPNB, Garstang's Level IX (Garstang et al. 1936), was renamed Pottery Neolithic A (PNA) by Kenyon (1957), due to this being the first occupation level that pottery became a significant part of the archaeological record. Kenyon had

no fixed date for the beginning of the PNA, but estimated it was about the second half of the 5th millennium B.C. (Kenyon 1957:94). There are no architectural remains associated with PNA Jericho. The identifying artifact of the archaeological assemblage is the pottery.

‘Ain Ghazal was extensively excavated in the 1980s and established itself as another type-site for the Levantine Neolithic. The PPNB occupational phase of Jericho is comparable to the Middle Pre-Pottery Neolithic B (MPPNB) of ‘Ain Ghazal. There are more phases identified within the ‘Ain Ghazal chronology as a result of improved radiocarbon dating techniques and an increased number of comparative site chronologies since Jericho was excavated. Unlike at Jericho, the excavators at ‘Ain Ghazal identified an occupation phase between the PPNB and the PN, the Pre-Pottery Neolithic C (PPNC). The excavators observed that the PPNC phase was distinct, but shared aspects of both the PPNB and the Yarmoukian Pottery Neolithic, the later occupational phase at the site (Simmons et al. 1988:36). Following the initial identification of the PPNC at ‘Ain Ghazal, the PPNC phase was recognised at other sites such as Yiftahel (Braun 1997), Atlit-Yam (Galili et al. 1988) and Wadi Shu’eib (Simmons et al. 2001).

Excavations at ‘Ain Ghazal revealed that the PPNC layer of occupation was more than one metre thick. The dates attributed to the PPNC were 6000 to 5700 or 5500 B.C. (Rollefson 1989:136). The uncalibrated radiocarbon dates from the PPNC occupation layer ranged from 7000±390 B.C. to 5720±100 B.C (Rollefson et al. 1992:445). The PPNC occupational phase was difficult to establish, as the PPNC occupants sometimes used the remaining PPNB structures as part of their architectural design. The later Yarmoukian inhabitants disturbed the PPNC deposits with the extensive digging of pits (Rollefson et al. 1992).

Following the PPNC, there are at least two identifiable cultures in the Southern Levant, but there is debate over their sequence and their characteristics. The Yarmoukian culture was identified at Sha’ar Hagolan and is dated from approximately 5600-5000 B.C. At Jericho, Garstang’s Jericho IX, renamed by Kenyon as Pottery Neolithic A (PNA), was the first identified stratum containing pottery. It is dated to the 6th millennium B.C. (Bartlett 1982:56-57) and is also referred to as the Lodian culture, renamed by the excavators of Lod (Gopher 1995). This thesis will refer to this archaeological phase by its original name, Jericho IX, to avoid confusion. There

is no scholarly consensus, however, with respect to the sequence and relationship between the Yarmoukian and Jericho IX cultural phases. Table 1.1 is a breakdown of the periods and dates discussed in this thesis.

Table 1.1 Periods and Dates of the Near Eastern Neolithic (Mazar 1990 and Rollefson et al. 1992).

Period	Phase	Begin B.C.	End B.C.
Natufian		10,500	8500
PPNA		8500	7500
Early PPNB		7500	7200
Middle PPNB	Phase 1	7200	7000
Middle PPNB	Phase 2	7000	6800
Middle PPNB	Phase 3	6800	6600
Middle PPNB	Phase 4	6600	6500
Late PPNB		6500	6000
PPNC		6000	5500
Yarmoukian/PNA		5500	5000

The two type-sites for the Southern Levant, Jericho and ‘Ain Ghazal, have established the basic chronological divisions PPNA, PPNB, and PPNC. Within this chronology there are often further sub-divisions, such as the PPNB being subdivided into Early (EPPNB), Middle (MPPNB) and Late (LPPNB), as more sites are excavated and chronologies become more refined. Following the PPNC, the sequence and relationship of the Yarmoukian and Jericho IX/PNA remains unclear. The three possible chronological relationships are: 1) that Jericho IX predates the Yarmoukian (Kaplan 1959:17; Kirkbride 1971:284); 2) the two assemblages are contemporary (Garfinkel 1993:115; Moore 1982:16), or 3) the Yarmoukian predates Jericho IX (Gopher and Gophna 1993:300; Gopher 1995:208).

The first three PN sites identified in Israel and Jordan were Jericho, Abu Usba, and Sha`ar Hagolan. The pottery from Abu Usba was lost during the Second World War (Kaplan 1959:15-16). The theory that Jericho IX predated the Yarmoukian was based on limited archaeological evidence and no radiocarbon dates. Some pottery sherds that were identified as having Yarmoukian decoration were discovered in the Jericho VIII layer (Kenyon's PNB), stratigraphically later than Jericho IX (Kaplan 1959:20). Stekelis, the archaeologist who identified the Yarmoukian culture, argued that Jericho IX post-dated the Yarmoukian based on the flint industry (Kaplan 1959:20). The chronology developed from the stratigraphy and archaeological assemblages during the large scale excavations at Munhata places the Yarmoukian earlier than the Jericho IX. The Yarmoukian occurs following a gap after the PPNB and earlier than the Munhata Phase, which was compared to Jericho IX (Gopher 1995:209).

As a result of the confusion regarding the chronology of the PN, Garfinkel (1999) attempted to collate radiocarbon dates on PN sites. Unfortunately, the continuing lack of adequate radiometric data from Jericho IX occupational layers made distinguishing the place of Jericho IX in the PN chronology difficult (Garfinkel 1999:10). However, on the basis of his excavations of the Yarmoukian type-site Sha`ar Hagolan, Garfinkel argues that the results of typological and geographical analysis point to Yarmoukian and Jericho IX being contemporary cultures located within separate geographical areas. There may be some geographical overlap between the cultures, but each is clustered in a specific area (Garfinkel 1993; Garfinkel and Miller 2002a).

Currently, the Yarmoukian is considered earlier than or contemporary with Jericho IX (Garfinkel 1999). The initial identification of some Yarmoukian pottery in a Jericho VIII/PNB context was not enough to establish that Jericho IX predates the Yarmoukian at Jericho. To complicate matters, the terms Jericho IX and PNA are often used interchangeably. For the purposes of this thesis Jericho IX will be used to avoid confusion and the term Pottery Neolithic (PN) will identify the period following the PPNC, which contains both Jericho IX and Yarmoukian regardless of their relationship to each other. The next phase, Wadi Rabah, stratigraphically follows both Jericho IX and Yarmoukian occupation layers (Gopher 1995:211).

Neolithic cultures are characterised on the basis of lithics, pottery and architectural assemblages. The evolving architecture of the PPN has been a subject of intense study (Byrd 2005), with the PPNB architecture in particular having been examined extensively (Banning 1996, 1998, 2003; Banning and Byrd 1987; Kuijt 2000). The architecture of the PN has been largely ignored, along with much of the PN culture as a whole, with the exception of ceramic typologies. The architecture at the Yarmoukian site of Sha`ar Hagolan is an exception. It has been examined and published (Garfinkel and Ben-Shlomo 2002a, 2002b). Although Sha`ar Hagolan is considered the Yarmoukian type-site, it is an anomaly amongst PN sites. It is currently the only single period PN site (Yarmoukian) that contains large scale architecture. Most of the sites that contain PN remains have limited to no architectural remains, such as Wadi Shu`eib, Tell Wadi Feinan, 'Ain Rahub (Kafafi 1993), and Jericho (Kenyon 1957). This is not because there is nothing to find, although in some cases that may be the reason, but because the PN has not been a major focus of excavators. Large tell sites such as Beth-Shan, Megiddo, and Lachish have Neolithic remains, but the focus of excavations at these sites has been later occupational periods (Moore 1985:3). The lack of interest in the PN may be because it is "too late for the Palaeolithic and too early for Biblical archaeology, the two main foci of interest" (Gopher and Gophna 1993:298). The analyses of the PN sites that have been excavated tend to focus on the ceramic assemblage, with minimal publication of the architectural remains.

The PPNB is known for its many well-preserved settlements, which contain structurally sound, well-maintained architecture. The construction techniques, particularly the heavy use of plaster, are observed at a multitude of sites over a widespread geographic area. The same painted lime plaster technique was observed at a number of sites including Beidha and Jericho (Banning and Byrd 1987; Kenyon 1957). The common house type for the Middle Pre-Pottery Neolithic B (MPPNB) to the Late Pre-Pottery Neolithic B (LPPNB) is known as the pier house and has been identified at Jericho (Kenyon 1957), 'Ain Ghazal (Banning and Byrd 1987), Yiftahel (Braun 1997), and Beidha (Byrd 2005). By the LPPNB, construction techniques had progressed to include channels under the floors and dressed masonry at Basta and Khirbet Hammam (Gebel et al. 1988; Nissen et al. 1991; Peterson 2004). All but one of the sites mentioned above, 'Ain Ghazal, were deserted within the PPNB. Architecturally the difference between the two periods PPN and PN is pronounced.

1.2. State of the Question

The end of the Pre-Pottery Neolithic and the transition to the Pottery Neolithic are not well understood. The introduction of the ceramic industry was first attributed to diffusion from the north, then to local development. The end of the PPN was marked by the desertion of many sites and the reasons for the abandonment of so many sites and subsequent change in architectural techniques and settlement patterns have not been determined.

To early scholars the emergence of the ceramic industry in the PN appeared to be sudden and was attributed to outside sources. By the 1990s the general consensus became that the Neolithic peoples of the Southern Levant developed pottery on their own (Banning 1998:206). The early assumption that the ceramic industry was imported from another area into the Southern Levant was conjecture with no actual research being done to prove or disprove the theory. Sites to the north, in Lebanon (Byblos) and Syria (Ugarit), were excavated and published prior to PN sites in the Southern Levant. These sites were used as comparative samples for Southern Levantine sites and since pottery was identified there first, there appears to have been an assumption that pottery originated in the north (Kenyon 1957:85; Mellart 1975:227; Perrot 1962:156). These observations were then cited by later scholars, with no actual analysis performed. Current studies attribute the rise of the ceramic industry to local development, with each region developing at approximately the same time. There was some overlap between regions, but differences could be observed in the style of decoration (Garfinkel and Miller 2002a:5).

The reasons for the demise of the PPN and the subsequent changes in the PN have not been definitively explained by archaeologists. Two of the earliest theories for the desertion of PPNB settlements were: 1) climate change or 2) overexploitation of the surrounding area of a settlement (Kirkbride 1971). Overexploitation, particularly by domesticated herds of goats, is the reigning theory for the abandonment of PPNB sites and climate change has been dismissed (Köhler-Rollefson 1988; Köhler-Rollefson and Rollefson 1990; Rollefson 1996). For example, the increased reliance on goat husbandry is considered the primary reason for the degradation of the catchment area surrounding 'Ain Ghazal, and the subsequent desertion of the site.

The Neolithic settlements of the Levant were primarily sedentary agricultural communities, some of which were continuously occupied for two thousand years. Ongoing exploitation of the catchment area, combined with human mismanagement, could have exhausted the natural resources surrounding a settlement. The excavation of 'Ain Ghazal included a study of the fauna and flora. This research documented a change in the subsistence strategy of the inhabitants. This change in subsistence strategy, the increased reliance on domesticated goats, is considered by the excavators to be the major cause for abandonment of the site.

In more recent years, a number of global and localized environmental studies have revived interest in the role of climate change in the desertion of PPNB settlements. Environmental determinism had been considered and dismissed, then reconsidered for an earlier cultural change in the Near East, the origin of agriculture (Wright Jr. 1993). Once worldwide and local palaeoclimatic studies were available and then correlated with radiocarbon chronology, the view changed. The same geologist, Wright Jr., who dismissed climatic determinism as a stimulus for the origin of agriculture in the Near East, later argued that climatic determinism could be a viable hypothesis (Wright Jr. 1993:467). As evidence becomes more readily available for the time period, re-examining earlier hypotheses about climate change becomes possible.

The Southern Levant is not the only area that shows evidence of settlement abandonment between the end of the PPNB and the PN. The Northern Levant also has evidence for site desertion at the end of the PPNB (Bar-Yosef 2002:122). Although an extensive study has been performed on the evidence retrieved from 'Ain Ghazal, the evidence is localised to a single area. The desertion of settlements is observed all across the Southern and Northern Levant and the cause or causes for these abandonments remains unclear.

1.3. Research Goals

The archaeological assemblages of the Pre-Pottery Neolithic and the Pottery Neolithic indicate transition problems between these two settlement phases. Some of these transitional issues can be explained in the context of a global cooling trend referred to as the 8.2 ka cold

event. The end of the PPNB saw a widespread desertion of major settlements (Banning 1998; Mellaart 1975:68). Settlements that were founded in the PN, the next archaeological phase, or that remained inhabited from the PPN to the PN show significant changes in the archaeological record. Documenting and explaining the changes, as evidenced in the study of the architecture, is one of the goals of this thesis and will be addressed in Chapter Two.

The end of the Pleistocene and the beginning of the Holocene saw the end of the Last Glacial Maximum. The melting of the ice sheets created large glacial lakes of freshwater. When the largest of these lakes in North America, glacial Lake Agassiz, emptied into the ocean, the effects could be felt all over the world. The sudden drainage of freshwater into the ocean caused a catastrophic effect on the climate, leading to important changes for the earth's population. The release of so much freshwater into the North Atlantic began the 8.2 ka cold event (a 300-400 year mini ice age) that has been observed all over the globe (Perkins 2002). The populations of the Near East experienced changes in settlement patterns, changes in the archaeological record and adopted different adaptive strategies at approximately the same time as the 8.2 ka cold event.

This thesis examines the 8.2 ka cold event as a way of explaining the changes in the Near Eastern archaeological record. The cause of the 8.2 ka cold event and the evidence of its effects observed all over the world will be explored in Chapter Three. The change in climate and subsequently, the environmental conditions, were observed in the Near East and the evidence for these changes will be investigated in Chapter Four. There are no studies directly linking the 8.2 ka cold event with any Southern Levantine sites, but the timing of the global event coincides with the end of the PPNB and the PPNC. "It is well-known that correlation does not mean causation. However, when major changes in both the natural world and the human sphere seem to have occurred at the same time, further investigations for possible causal relationships is called for" (Bar-Yosef 2001:133).

Although a direct link between the collapse of any PPN site in the southern Levant and the 8.2 ka cold event has not yet been established, the lack of cohesion observed at PN sites could be an indication of an unstable living environment. The variation in settlement patterns and the archaeological assemblages of the PN does not indicate an organised and unified point of

view or response by the PN populations. I argue that the PN population used different adaptive strategies to cope with shifting environmental conditions from the PPN to the PN. The different adaptive strategies used by the population of the PN will be discussed in Chapter Five.

1.4. Methodology and Data

The availability of paleoclimatic data, at the worldwide, regional, and local levels has greatly increased over the years. Pollen studies, oxygen and carbon isotopic composition of speleothems, studies of Greenland ice cores, faunal and floral analyses, reports on the effects of retreating glaciers and the emptying of glacial lakes are all available. The information does tend to be presented in a general manner, so applying it to specific Near Eastern sites may be difficult. But, these data do suggest a general pattern of climate change and will be used to support the theory of climate change, in particular the 8.2 ka cold event, as a reason for the abandonment of PPN sites and the subsequent changes in the PN culture.

During the earlier Natufian Period an amelioration of climate conditions followed by the Younger Dryas coincided with the transition from complex foraging to agriculture. Henry (1989) has argued that although climate was not a causal factor it was important to the timing and the “transition was caused by the inherent instability of the Natufian adaptive system” (Henry 1989:40). Following Henry’s approach this thesis will examine the adaptive strategies of the PPN and the PN inhabitants to the 8.2 ka climate event. The category of Neolithic assemblages that will be the focus this thesis is the architecture.

The architecture from nine PPN and nine PN sites has been examined for this study. The PPN sites tend to be well-published, large scale excavations, whereas the PN sites are often small, single season excavations with limited publications. The plethora of PPN architectural data have been compared to the limited amount of PN architectural data. Very few of the sites have final reports, an ongoing problem in Near Eastern archaeology. If they are available they have been used in this study. In general, secondary reports from sites; end of season reports and articles addressing specific aspects of sites were used for research purposes. Three aspects of the

architecture have been examined to explicate the possible socioeconomic change from the PPN to the PN: construction technique, layout, and use. Construction technique, layout and use were chosen because changes in these technological and spatial systems could indicate a disruption in the social organisation of the population. The improvement in or degeneration of construction technique could be representative of the cohesiveness or disorder of the population, or a significant shift in social structure and/or subsistence strategies. The layout of a structure or settlement characterises the spatial organisation of a people “as between the house and the household, the [architectural] structure of the one providing an analogue to the structure of the other” (Wilson 1988:60). The layout of structures from the PPNB was remarkably consistent within and between sites. Consequently the socio-economic status of the PPNB population is considered stable. There is no evidence for economic inequality (Banning 1998:222). Interpreting the use of structures in the PN is difficult since there has not been found at the majority of PN sites a single structural design that could be identified as belonging to a household. Also, much of the architecture consisted of single room dwellings. Thus interpreting the division of space within structures is currently not possible. Although the use of individual structures may be impossible to determine at this time, the floral and faunal evidence of a settlement can be used to determine economic conditions. The combination of these three aspects of culture in the PPN and PN has been used to determine the extent of change from the early to the late Neolithic.

The transitional period between the PPN and the PN coincides with 8.2 ka event. By examining the climatic and paleoenvironmental data associated with this time and the architectural data from the Southern Levantine PPN and PN sites this thesis aims to shed some light on the reasons for the demise of the PPN. Similar to Henry’s (1989) work on the Natufian transitional period, this thesis will study the adaptive strategies of the PN population following the demise of the PPN to determine any effects the 8.2 ka event may have had on the inhabitants.

Chapter 2: Transition from the PPN to the PN

The transition from the PPN to the PN was accompanied by a variety of changes in the archaeological record. Settlement patterns, subsistence patterns, industry, and architecture are all aspects of the archaeological record that will be discussed in the following chapter. In order to examine the adaptive strategies used in the PN, the archaeological record of the PPN must be discussed and used for comparative purposes.

2.1. Settlement Patterns

“The Levant presently enjoys a remarkably complex mosaic of environmental settings, particularly for such a small area dominated by a generally arid climate” (Henry 1989:57). The variety of environmental settings affected the settlement patterns of the Southern Levant. As the Levant bridges three continents Africa, Asia and Europe, therefore, there are three major phytogeographic zones in the Levant: Mediterranean (Europe), Irano-Turanian (Asia), and Saharo-Sindian (Africa). Each of these zones has “quite different moisture and temperature requirements” (Henry 1989:63). As the majority of PPN and PN sites relied on agriculture as a primary form of subsistence, moisture and temperature were very important factors in settlement patterns.

2.1.1. Pre-Pottery Neolithic Settlement Patterns

Sedentism began during the Natufian Period (10,500-8500 B.C.) in the Near East, but a substantial increase in settlements is only observed in the PPNB (7500-6000 B.C.). Towards the end of the PPN the number of settlements decreased, but the sizes of the remaining sites increased. When studying the Levantine Neolithic there are two geographical areas to consider: the Northern Levant and the Southern Levant (Rollefson 1996). All of the sites examined in this thesis are located in the Southern Levant. Within the Southern Levant are four physiographic units (Figure 2.1), listed in order from the Mediterranean Coast inward: the coastal plain, hill zone, Rift Valley, and the Jordanian Plateau (Henry 1989).

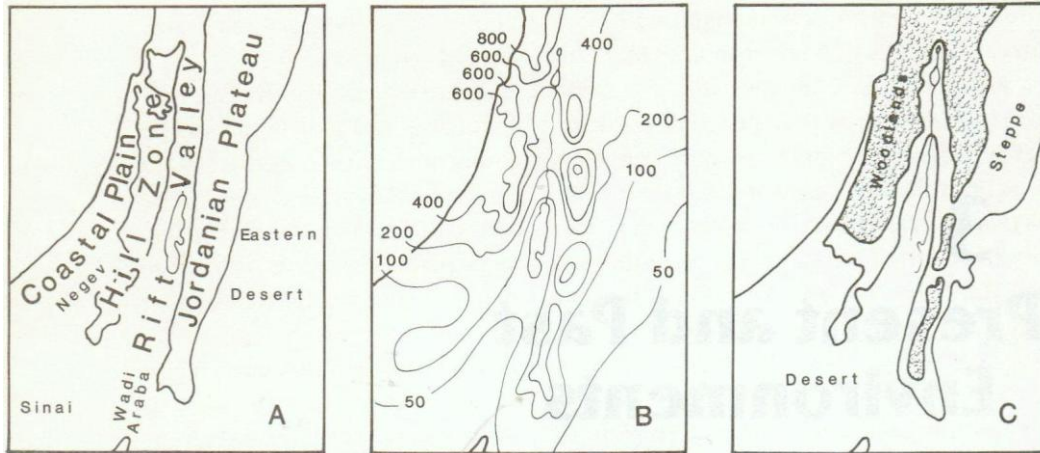


Figure 2.1. Map of the Levant showing the relationships between (A) physiography, (B) rainfall in mm, and (C) vegetation communities. (Henry 1989:58) Reprinted with permission of the University of Pennsylvania Press.

The number and distribution of settlements in this region show little significant increase in the PPNA. The sites are primarily located within the coastal plain and the Rift Valley, on low ground, near cultivable land and a water source (Moore 1985:15-16). Jericho, the only site with a PPNA occupation relevant to this study, is located in the Rift Valley, 275 metres below sea level near a perennial stream (Kenyon 1985:22). The PPNA Jericho occupation was approximately four hectares in size, the largest known PPNA site (Moore 1985:16).

The number of PPNB settlements shows a substantial increase, with all four physiographic zones of the Southern Levant occupied. The sites in this study, excluding Jericho, were all established at different times during the PPNB, and in three of the four physiographic zones. ‘Ain Ghazal and Beidha were settled within the EPPNB (Rollefson 1992) and Jericho was reoccupied, after a brief period of abandonment (Bartlett 1982:47). ‘Ain Ghazal is located on the Jordanian Plateau, near Amman, Jordan, adjacent to the longest drainage system on the Jordanian Plateau. It is located between oak-park woodland and open steppe-desert “on the 250-mm isoheyt, which is the minimum amount of precipitation required for non-irrigation farming” (Simmons et al. 1988:37). Beidha, also on the Jordanian Plateau, is located in a wadi, on a north-south terrace 4 km wide, with sandstone cliffs, backed by the limestone ridge of Jebel Shara` on the east side and bordered on the west side by an abrupt drop to the Wadi Araba (Kirkbride 1966a:199). As previously mentioned, Jericho is located within the Rift Valley.

Wadi Shu'eib (Simmons et al. 2001) and Yiftahel (Braun 1997) were established in the MPPNB. The site of Wadi Shu'eib is located 375-380 m above sea level on the north bank of the wadi. It is on the Jordanian Plateau close to the Rift Valley to the west. Wadi Shu'eib is approximately 20 km west of 'Ain Ghazal (Simmons et al. 2001:4). Yiftahel is found on the coastal plain, located approximately halfway between the Mediterranean and the Sea of Galilee, on the eastern bank of the Wadi Yiftahel (Garfinkel 1987:200).

Basta and Khirbet Hammam were settled in the LPPNB (Rollefson 1992) and Atlit-Yam was a PPNC site (Kislev et al. 2004). Basta is a LPPNB site at least 10 ha in size situated less than 20 km southeast of Beidha on the Jordanian Plateau. Basta is 1420-1460 m asl, where precipitation can vary from 200-300 mm to 50-100 mm a year (Gebel et al. 1988:103). Khirbet Hammam was discovered during the Wadi el-Hasa Survey, begun in 1979 by Dr. Burton MacDonald (MacDonald 1988). The 2-4 ha site is located on a terrace overlooking the Wadi el-Hasa, where the main wadi merges with several smaller wadis (Peterson 2004:4). Khirbet Hammam is situated on the Jordanian Plateau approximately halfway between Wadi Shu'eib and 'Ain Ghazal to the north and Beidha and Basta to the south. Atlit-Yam is a submerged PPNC site, located at a depth of 8-12 m and 200-400 m off the Northern Carmel Coast of Israel. Although Atlit-Yam is now underwater, when it was inhabited it would have been located on the coastal plain. The Mediterranean Sea rose continuously from 8000 yr. B.P. until approximately 1500 yr. B.P., submerging a number of Neolithic sites, of which Atlit-Yam is the oldest (Galili et al. 1988:37-39).

At least 140 PPNB and PPNC sites have been identified in the Levant, spread across all four physiographic zones (Moore 1985:19). The early PPNB saw an increase in the number of sites and site sizes from the PPNA, reflecting an overall increase in population. By the LPPNB, many sites were abandoned, such as Jericho and Beidha. By contrast some sites increased dramatically in size, becoming mega-sites (sites over 10 ha in size). 'Ain Ghazal, Wadi Shu'eib, and Basta located on the Jordanian Plateau, all became mega-sites (Rollefson 1989:137). In the PPNC, 'Ain Ghazal and Wadi Shu'eib, and possibly Basta were still occupied, along with Atlit-Yam on the coastal plain. Currently there is a limited number of identified PPNC sites, including

Tel Ali and Ashkelon along the coastal plain (Garfinkel 1999:9). The PPN sites examined in this study and their physiographic zones are presented in Table 2.1.

Table 2.1 Physiographic location of PPN sites and their occupation levels.

Site	Physiographic Zone	PPNA	EPPNB	MPPNB	LPPNB	PPNC	PN
Jericho	Rift Valley	X	X	X			X
‘Ain Ghazal	Jordanian Plateau		X	X	X	X	X
Beidha	Jordanian Plateau		X	X	X		
Wadi Shu`eib	Jordanian Plateau			X	X	X	X
Yiftahel	Coastal Plain			X		X	
Basta	Jordanian Plateau				X		
Khirbet Hammam	Jordanian Plateau				X		
Atlit Yam	Coastal Plain					X	

During the PPN in the Southern Levant, the number of sites increased steadily from the PPNA to the PPNB, peaking during the PPNB. By the late PPNB the number of sites had decreased dramatically, but the size of the remaining sites increased. The PPNA sites were mainly concentrated on the coastal plain and within the Rift Valley. The increase in sites in the PPNB covered all four physiographic zones. By the end of PPNB and during the PPNC sites were concentrated almost exclusively on the Jordanian Plateau, with a few small settlements along the coastal plain.

2.1.2. Pottery Neolithic Settlement Patterns

The settlements of the Pottery Neolithic are concentrated in two physiographic zones, the Jordanian Plateau, where most of the LPPNB and PPNC sites are located, and the Rift Valley. The sites used in this study are all located within these two areas. ‘Ain Ghazal and Wadi Shu`eib had a continuing occupation from the PPN, Jericho was re-occupied in the PN and a number of other sites, such as Jebel Abu Thawwab and Dhra` were established in the PN.

This study examines four sites found on the Jordanian Plateau, two of which, 'Ain Ghazal and Wadi Shu'eib were occupied in the PPN and have already been described. 'Ain Rahub is located in Northern Jordan, on a lower terrace of the west bank of Wadi ar-Rahub (Muheisen et al. 1988:475). The size of the settlement is unknown. Jebel Abu Thawwab is located approximately 40 km south of 'Ain Rahub and 20 km north of 'Ain Ghazal. Jebel Abu Thawwab is surrounded by a number of water sources, including springs fed through the Wadi ar-Rumman (Kafafi 1988:451). During a survey of the area, six smaller sites were found surrounding Jebel Abu Thawwab, indicating it was the central village for the area (Kafafi 1992). All four of these sites have been designated as having Yarmoukian cultural remains, with Wadi Shu'eib also showing elements of the Jericho IX culture.

The Wadi ath-Thamad Neolithic sites are located on the Jordanian Plateau, in the ath-Thamad Graben. Several sites, including WT-40 are located on an alluvial terrace, within the Irano-Turanian environmental zone (Cropper 2002; Foley et al. 2004). The Irano-Turanian zone receives 200 mm to 350 mm of precipitation in the winter months (Henry 1989:64), placing it within the required minimum of 200 mm for dry farming (Hopkins 2003:127). At high elevations the primary tree, *Pistacia atlantica*, can be found, but the predominant florae are brush or dwarf bushes. Sagebrush (*Artemisia herbae-alba*) is the most common (Henry 1989:64).

The ath-Thamad Graben (Figure 2.2) was formed by three surrounding faults (Cropper 2002:10), with two major wadis, the Zafaran and the Thamad, running through the depression (Foley et al. 2004:1). Wadis Shabik and Ruwaq drain into Wadis Thamad and Zafaran, which feed into Wadi el-Wala, which in turn drain into Wadi Mujib and finally into the Dead Sea (Cropper 2002; Foley et al. 2004). The ath-Thamad Graben controls the drainages of Wadi ath-Thamad and its tributaries, reducing stream gradients and causing abundant sediment deposition (Cordova et al. 2005:33). Stream incision of these sediment deposits creates terraces of alluvial and/or colluvial fills (Cordova et al. 2005:35). WT-40 is located on one of these terraces.

The Thamad terrace is the highest of the aggradational terraces, located approximately 10-20 m above the wadi bottom. It was formed through accumulation in three phases, Thamad I, II, and III, from 19,000 to 8000 cal. yr. B.P. (Cordova et al. 2005:43). The PN material, the

concern of this thesis, is located within the Thamad III colluvial and alluvial deposition, consisting of 2 m of alternating silts and gravels (Cordova et al. 2005:46). The Thamad terrace is heavily eroded by gullies, particularly on the north and south sides (Foley et al. 2004:2).

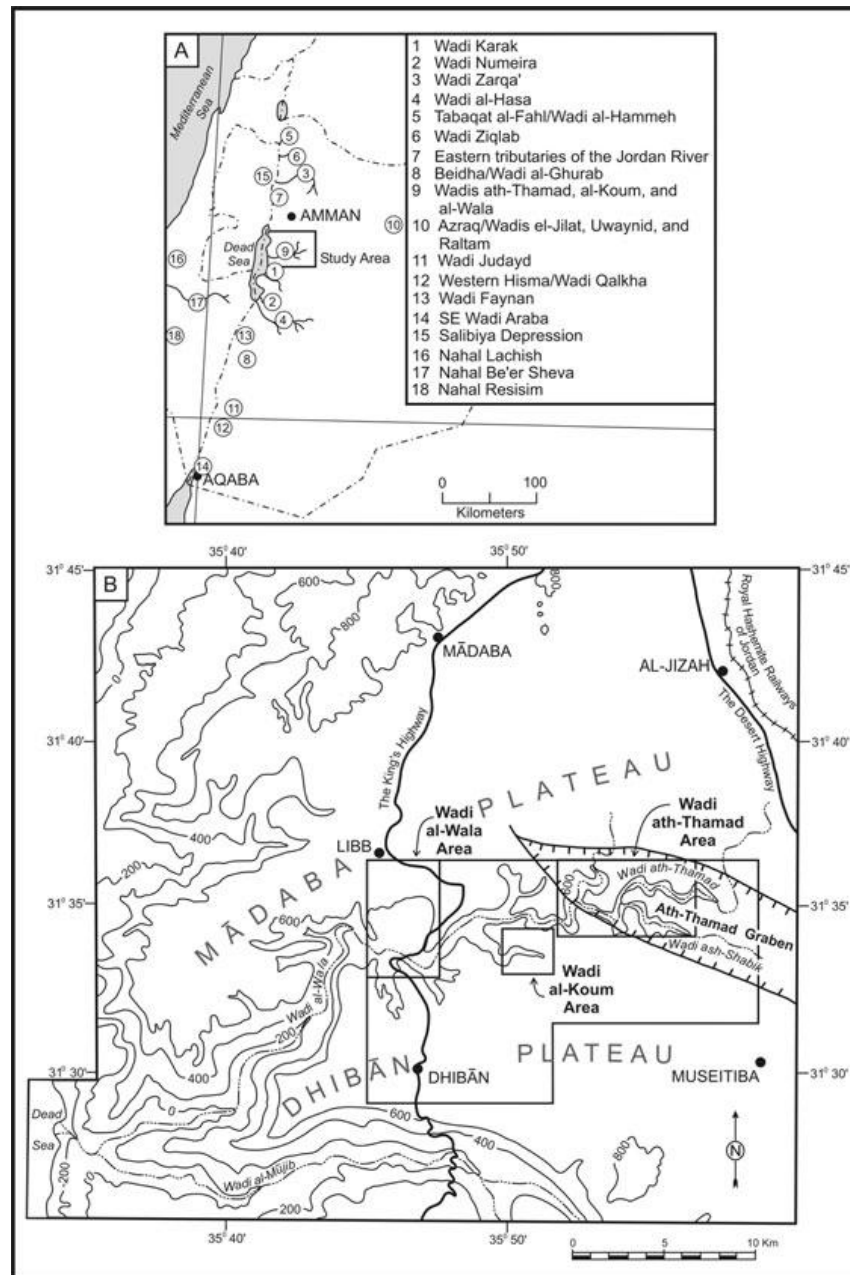


Figure 2.2. (A) Study area. (B) The wadi systems in the Wadi ath-Thamad study area. (Cordova et al. 2005:31) Copyright 2010 by John Wiley and Sons <http://onlinelibrary.wiley.com.cyber.usask.ca/doi/10.1002/gea.20036/abstract>. Reprinted with permission.

A number of PN sites have been identified in the Rift Valley, two of which are the type sites for the two PN cultures found in the Southern Levant. Sha`ar Hagolan, the Yarmoukian type site, is located 1.5 km south of the Sea of Galilee, 210 m below sea level, on the north western bank of the Yarmouk river (Garfinkel and Miller 2002b:10). Jericho, the Jericho IX type site, has been discussed above. Dhra` is situated 80 km south of Jericho, 40 m below mean sea level. The Dhra` settlement had access year round to water running in the Wadi Dhra` from the 'Ain Waida springs (Kuijt and Mahasneh 1998). Dhra` is also a Jericho IX site. Tell Wadi Feinan, a Yarmoukian site, is in the South of Jordan, North of Beidha. It is the most southern PN site in this study (Najjar et al. 1990). It is approximately 280 m above sea level, on the south bank of the Wadi Feinan (Kafafi 1993:104). The following table (Table 2.2) lists the sites and their physiographic zones used in this study.

Table 2.2. Physiographic location of all sites used or mentioned in this study and their occupation levels.

Site	Physiographic Zone	PPNA	EPPNB	MPPNB	LPPNB	PPNC	PN
Jericho	Rift Valley	X	X	X			X
'Ain Ghazal	Jordanian Plateau		X	X	X	X	X
Beidha	Jordanian Plateau		X	X	X		
Wadi Shu`eib	Jordanian Plateau			X	X	X	X
Yiftahel	Coastal Plain			X		X	
Basta	Jordanian Plateau				X		
Khirbet Hammam	Jordanian Plateau				X		
Atlit Yam	Coastal Plain					X	
'Ain Rahub	Jordanian Plateau						X
Jebel Abu Thawwab	Jordanian Plateau						X
Sha`ar Hagolan	Rift Valley						X
Dhra`	Rift Valley						X
Tell Wadi Feinan	Rift Valley						X
Wadi ath-Thamad	Jordanian Plateau						X

The PN sites used for this study are all located within the Jordanian Plateau and the Rift Valley. All of the sites on the Jordanian Plateau were Yarmoukian occupations, while in the Rift Valley there is a mixture of Yarmoukian and Jericho IX occupations. Overall fewer PN sites

have been identified than PPN sites in the Levant. Moreover, the settlement pattern changes from the PPN to the PN. In the PPN, sites are widespread throughout the Levant. By the PN, sites are concentrated in a more contained area, particularly on the Jordanian Plateau and the Rift Valley.

2.1.3. Summary

At least 140 sites have been identified with PPNB and PPNC components (Moore 1985:19). In the early PPNB the sites were located in all four physiographic zones of the Levant. Towards the end of the PPNB and during the PPNC, sites became primarily concentrated in one physiographic zone, the Jordanian Plateau. In the PN, sites are clustered in two physiographic zones, the Jordanian Plateau and the Rift Valley (Moore 1985).

The change in settlement patterns in the Southern Levant from the PPN to the PN shows the population moving from a woodland Mediterranean environment to a steppe Irano-Turanian environment. Bar-Yosef (2002) composed a map of the PPN entities with respect to subsistence economies (Figure 2.3). The map reflects a transition from farmers-herders in the PPN, to

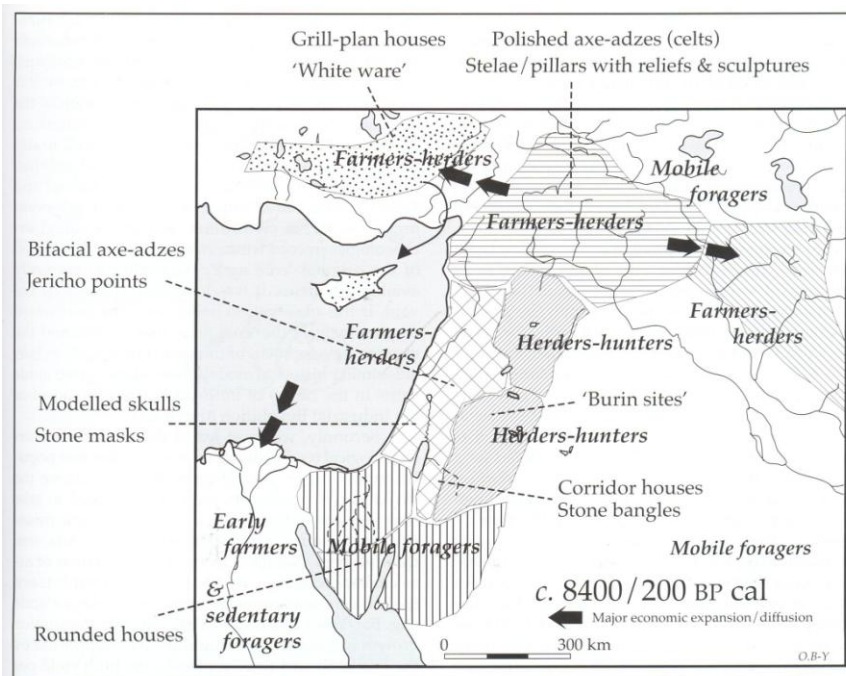


Figure 2.3. Map of PPNB entities and their subsistence economies. (Bar-Yosef 2002:121) Reprinted with permission.

herders and hunters in the PN. Coinciding with the settlement pattern change, a change in subsistence economy has been observed at PN sites, in particular the adoption of animal husbandry in the form of goat herding. The population now depended upon domesticated goat for a significant proportion of their economy. Settlement patterns may reflect new dependencies.

2.2. Subsistence and Industry

2.2.1. Pre-Pottery Neolithic Subsistence and Industry

“The emergence of agriculture is the essence of the Neolithic revolution” (Mazar 1992:42) Settlements of the PPNA relied upon a mixture of agriculture and hunting for their subsistence base and the lithic industry reflected this. During the PPNB, the domestication of sheep and goat gradually replaced hunting as the primary source of meat (Moore 1985:23). The adoption of agriculture as the primary economic base for the PPN allowed for the growth of large, permanent settlements.

In the PPNA, the cultivated crops consisted of einkorn, barley, lentils and legumes (Mazar 1992:42). Animals were not yet domesticated, but the hunting patterns demonstrated an “increasingly selective pattern of animal exploitation”, as the majority of the animals were immature (Moore 1985:22). At Jericho, the hunting of gazelle, cattle, goat, and boar provided meat for the settlement, with gazelle being the most prominent (Kenyon 1985:50). The PPNA lithic industry at Jericho continued the earlier Natufian tradition of a microlithic industry. The adzes, axes, sickles and chisels are indicative of farming and woodworking. Small arrowheads, such as the Khiamian point, were used for hunting. And ground stone tools, such as querns became common at sites (Mazar 1992; Mellaart 1975; Moore 1985).

The progression of agriculture during the PPNB led to the cultivation of two-row barley and double-row emmer wheat (Mazar 1992:45). At ‘Ain Ghazal, twenty-four taxa of seed-producing plants were identified, the most common being field peas, lentils, emmer and einkorn wheat (Köhler-Rollefson and Rollefson 1990:4). During the PPNB, the lithic industry became

blade dominated, as opposed to the microliths of the PPNA. Blades were used as sickles and with further lithic reduction as burins. Burins are chisel-like and it is believed that one of their uses was for woodworking or the engraving of bone (Banning 1998:201-202).

A major development from the PPNA to the PPNB is the domestication of sheep and goats, altering the socioeconomic base of Neolithic settlements. A full analysis of the faunal remains from 'Ain Ghazal has been performed, particularly in regard to the domestication of goats (Köhler-Rollefson 1988; Köhler-Rollefson 1989; Köhler-Rollefson and Rollefson 1990). During the early PPNB, the hunting of wild animals still accounted for approximately 50% of the meat consumed at 'Ain Ghazal (Köhler-Rollefson and Rollefson 1990:4). By the PPNC, over 90% of the faunal remains came from domesticated animals (Köhler-Rollefson 1988:91). Almost 70% of the domesticated faunal remains were identified as goat (Köhler-Rollefson and Rollefson 1990:6). The rapid change from the hunting of wild game to the almost complete reliance on domesticated meat suggests "that major socio-economic adjustments had taken place in a relatively short time" at 'Ain Ghazal (Köhler-Rollefson and Rollefson 1990:5). This change in subsistence strategy, the increased reliance on domesticated goats, is considered the primary factor for abandonment of the site.

Coinciding with the faunal changes at 'Ain Ghazal is the reduction in wood usage. Construction posts first become smaller in diameter, then were replaced with stone piers. The ash deposits within hearths were now consistent with dung fuel (Köhler-Rollefson and Rollefson 1990:6). Allowing goats to graze in the non-agricultural areas surrounding a site like 'Ain Ghazal was disruptive to the already exploited environment. Another tax on the environment was the use of lime and plaster for floor surfaces. One of the characteristics of the PPNB was the use of lime plaster to cover walls and floors within buildings. Lime plaster was used at 'Ain Ghazal (Kingery et al. 1988:224). The process for making lime plaster requires the heating of limestone to 800-900°C, with constant fuel additions. To create a ton of lime plaster in an open pit it has been calculated that four tons of wood would be required (Kingery et al. 1988:221). Using these calculations, combined with the use of timber in building construction, the excavators calculated the inhabitants used 3176 hectares of timber from 7250 B.C. to 5450 B.C., deforesting a 3 km radius around the settlement (Rollefson and Köhler-Rollefson 1992:247).

The replenishment of the forested area surrounding ‘Ain Ghazal could not be maintained due to overexploitation and the grazing of goats. Goats cannot damage grown trees, but they feed on young trees and shrubs, preventing replenishment (Köhler-Rollefson 1988:90). The lack of trees and undergrowth in the areas surrounding the settlement would speed the deterioration of the environment, causing soil erosion in particular. Top soil is easily eroded when there are no trees or shrubs protecting it from the elements. ‘Ain Ghazal is and was located in a marginal area, where “the absence of plant cover and soil-binding roots during extended parts of the year increased the susceptibility of the surface soil to erosion” (Köhler-Rollefson 1988:89). Overexploitation of the woodland environment combined with grazing would have sped up this process.

The importance of goat as the primary meat source at the end of the PPNB and throughout the PPNC is demonstrated at a number of sites. Unlike at ‘Ain Ghazal, not all the goat remains that have been identified were from domesticated herds. At Basta the highest percentage of faunal remains is goats, but the excavators identified the remains as both wild and domestic (Nissen et al 1987:116). The analyses of the faunal remains at Beidha indicate a similar situation; two species of wild goat were identified (*Capra hircus aegagrus* and *Capra ibex nubiana*), but the large number of young animals slaughtered indicates domestication (Perkins Jr. 1966b:67). All the faunal remains at the PPNC site of Atlit-Yam have been identified as wild. Goat (*Capra aegagrus*) and cattle (*Bos primigenius*) are almost equally represented (Galili et al. 1993:147-149). Regardless of whether or not the goat was domesticated at all PPNB sites, it did become the primary source of meat for the majority of PPNB and PPNC settlements.

An increased reliance on wild or domestic goat did not diminish the importance of cereal cultivation to a settlement. In fact, a mixed economy may have allowed for increased stability at a site. Unfortunately, the botanical evidence at PPNC sites is extremely limited. The flotation samples from ‘Ain Ghazal yielded no botanical remains and only a small number of sickle blades and grinding stones were recovered. Thus there is little evidence for agriculture (Köhler-Rollefson and Rollefson 1990:6). Yet, agriculture must have remained important. The PPNC settlement is estimated to have been 12-13 ha and could not have survived on goat alone (Rollefson et al. 1992:446). The evidence from Atlit-Yam is more substantial. In fact, the largest

cereal grain sample for a PPN site was recovered here. The majority of the 26,000 grains recovered were identified as hulled emmer wheat (Galili et al. 1993:150-151). The lithic assemblage of Atlit-Yam is dominated by arrowheads and sickle blades (Galili et al. 1993:140). Overall, the lithic industry of the PPNC is flake-dominated as opposed to the blade-dominated industry of the PPNB. Because the PPNC lithic industry is flake-dominated it is sometimes interpreted as requiring minimal skill. The tools, particularly sickle technology, was being created with flakes as opposed to blades and therefore are considered expedient instead of specialised (Banning 1998:203).

Agriculture combined with hunting provided a stable economic base for the early PPN peoples. As settlements expanded in the PPNB, so did the economic diversity. Animal husbandry joined agriculture and hunting, creating mixed economies at many sites, in all four physiographic zones. By the end of the PPN, many sites relied almost exclusively on goat (wild or domesticated) for their meat, as opposed to gazelle which was the primary meat source in the early PPN. The lithic industry of the PPN reflected the needs of the subsistence base. The majority of the tools associated with the PPN appear to have been used in the processing of grains. The stable economic base of the PPN allowed for a previously unprecedented growth in settlement size.

2.2.2. Pottery Neolithic Subsistence and Industry

The evidence for the subsistence economy of the Pottery Neolithic is limited in nature as many sites do not have botanical remains, but appear to continue the trends begun in the Late PPNB. The lithic industry is similar to the LPPNB and the PPNC. The major cultural change comes in the introduction of pottery to the archaeological assemblage. Although two archaeological cultures have been identified in the Southern Levant for the early PN, almost all the subsistence information comes from the Yarmoukian culture. The Jericho IX sites have provided some evidence of the lithic and ceramic industries.

Floral remains have been recovered at three Yarmoukian sites, Jebel Abu Thawwab (Kafafi 1988), 'Ain Rahub (Muheisen et al. 1988), and Sha`ar Hagolan (Allen 2002). A preliminary analysis of the Sha`ar Hagolan botanical remains has been published, but could not be statistically compared with Jebel Abu Thawwab and 'Ain Rahub. The botanical remains at these two sites have only been identified as present or absent and in relative amounts within each site (Allen 2002:244). At Jebel Abu Thawwab, lentil is the principal crop recovered followed by emmer wheat (Kafafi 1988:466). 'Ain Rahub provides a little more information about cereal cultivation. The primary crops were emmer wheat and two-rowed hulled barley. Domesticated flax has also been identified. Wood samples all belonging to a deciduous oak species, *Quercus ithaburensis*, a few of which were observed in the area at the time of excavation (Muheisen et al. 1988:497).

Plant remains from three seasons of excavations (1997-1999) at Sha`ar Hagolan have been analysed. The density of remains is low (Allen 2002:243). In all three seasons, the most common cultivated species are wheat, primarily emmer and einkorn, followed by barley, with legumes being rare (Allen 2002:242). Almost no wood samples were recovered; those that were are fragments smaller than 1 cm² (Allen 2002:243). The lack of wood remains is explained by the recovery system used during excavations; only some flotation and water-sieving was performed. In the areas excavated there was a lack of hearth deposits where wood is commonly found. There is the possibility that dung was the primary fuel source (Allen 2002:243-244).

No plant remains have been recovered and published from Jericho IX occupations, but at Dhra` there is other evidence for a farming society. Terrace walls located southwest of Dhra` and dated to the PN period have been identified, of which two were excavated (Kuijt et al. 2007:109). The excavators argue that the terrace walls "may have been linked to the need to minimise soil erosion and control water runoff...and as field systems for growing wild and domesticated plants" (Kuijt et al. 2007:115). Although no plant remains were identified at Jericho IX sites, it is assumed agriculture was practised (Gopher 1995:211).

The faunal remains for the early PN are not much more illuminating than the limited plant remains. Again, the majority of the data comes from Yarmoukian, as opposed to Jericho

IX, PN settlements, but even then the information tends to be limited to one or two sentences within a report. There is no information on faunal remains from 'Ain Rahub, while at Jebel Abu Thawwab the sample size is only 125 bones, 68% of which were identified as *Ovis/Capra* (Kafafi 1988:466). The majority of the bones recovered at Tell Wadi Feinan also belong to sheep and goat, but no further information is available (Kafafi 1993:104). The Yarmoukian phase at 'Ain Ghazal continues the trends of the PPNC. Goat husbandry accounts for 70% of the remains, but the smallest numbers of recovered remains are associated with the Yarmoukian phase (Köhler-Rollefson and Rollefson 1990:6).

The PPNB occupation of 'Ain Ghazal relied on a varied agricultural base, the hunting of wild animals, and the exploitation of animals in a manner consistent with early domestication. Twenty-four taxa of seeds were recovered and wild animals still composed half of the faunal record (Köhler-Rollefson and Rollefson 1990:4). In the PPNC, after 6200 B.C., goats composed almost 70% of the faunal record and the variety of identifiable species drops by more than half. The flotation samples from the PPNC deposits yielded no evidence of the agricultural economy (Köhler-Rollefson and Rollefson 1990:6). The Yarmoukian phase of occupation is very similar to the PPNC. Goats compose 71.3% of the fauna, and the number of identified species drops from the PPNB. As with the PPNC the floral taxa of the PN is unknown (Köhler-Rollefson and Rollefson 1990:6).

As previously discussed, the increased reliance on goat husbandry is considered the primary reason for the degradation of the catchment area surrounding 'Ain Ghazal, and the subsequent desertion of the site (Köhler-Rollefson and Rollefson 1990). Goat husbandry and a sedentary, agricultural lifestyle in a semi-arid environment do not coexist in the same catchment without damage to one or the other. The rotation of land use between agriculture and animal husbandry was not possible. Once land has been cleared for agricultural use, the plant species required for pasturage do not regenerate, without help, during the fallow period. Therefore, once agricultural fields are in place, pasturage requirements must be found elsewhere (Köhler-Rollefson and Rollefson 1990:10). The rise in goat husbandry could have disrupted the agricultural production at 'Ain Ghazal and encouraged overexploitation of the surrounding area.

At Sha`ar Hagolan, sheep and goat remained the most predominant taxa at 56% of the sample. Pigs account for 17% and cattle about 11% (Hesse 2002:249). The sheep, goat and pig are all considered domesticated; cattle may have been domesticated but osteometric criteria or a large enough sample size is not yet available for comparison (Hesse 2002:255). The excavators were concerned about the lack of fish and amphibian remains, since Sha`ar Hagolan is located on the bank of the Yarmouk River. Other zooarchaeologists who have worked in the Jordan Valley argue that the lack of aquatic species is due to material preservation conditions (Hesse 2002:248).

The evidence for the subsistence economy of the early PN in the Southern Levant is very limited. Only a small number of sites, Yarmoukian or Jericho IX, have yielded botanical remains. Wheat and barley are predominant at Sha`ar Hagolan (Allen 2002) and 'Ain Rahub (Muheisen et al. 1988), while legumes are the most common at Jebel Abu Thawwab (Kafafi 1988). The faunal remains indicate a reliance on domesticated sheep and goat in the early PN. The majority of the floral and faunal evidence comes from Yarmoukian sites. The subsistence economy of the PN appears to be a mixed economy, with a focus on domesticated goat and the cultivation of cereal crops.

2.2.3. Pottery Neolithic Lithic and Ceramic Industries

The early PN flint industry is dominated by flakes, as opposed to the blade-dominated PPNB. Once again the majority of the information comes from the Yarmoukian sites and very little from Jericho IX sites. The lithic assemblage at Sha`ar Hagolan, dominated by flakes, has been interpreted as “opportunistic in nature” (Alpersen and Garfinkel 2002:148). The tools associated with the early PN are short, barbed arrowheads, burins and truncated, heavily denticulated sickle blades (Rollefson 2003:259). The denticulated sickle blade has been identified at 'Ain Rahub (Kafafi 1993); Jebel Abu Thawwab (Kafafi 1988); Tell Wadi Feinan (Najjar et al. 1990); 'Ain Ghazal (Kafafi 1993); and Sha`ar Hagolan (Alpersen and Garfinkel 2002). The general function of the sickle blade is for harvesting and reaping, according to Rosen's (1997) functional classification. The appearance of the sickle blade at the majority of PN sites is indicative of some form of agricultural processing.

At Wadi ath-Thamad the lithic assemblages are dominated by flake technology and expedient tools (Foley et al. 2004:19). Some of the identified tools are Haparsa and Nizzanim points, tile knives, drills, awls, and a high proportion of burins (Cropper 2002; Foley et al. 2004). Burin sites are associated with pastoralism and although WT-40 and WT-104 were not identified as burin sites, they did have a significantly high proportion of burins (Cropper 2002; Foley et al. 2004). Sickle blades, adzes and ground stone tools were significantly under-represented. These tools would be used in agricultural communities, for the processing of cereals. The lack of tools associated with agriculture, and the high percentage of burins in the lithic assemblage indicates a pastoral community (Cropper 2002:38).

Hunting remained part of the PN economy. While the highest percentage of faunal remains is from domesticated animals, the remains of hunted animals are still found. Six percent of the faunal remains at 'Ain Ghazal and 15% of the remains at Jebel Abu Thawwab are gazelle bones (Gopher and Gophna 1993:314). The function of arrowheads is for hunting (Rosen 1997:117) and they are still found at many PN sites, such as Jebel Abu Thawwab (Kafafi 1988), 'Ain Ghazal (Rollefson 1993), Tell Wadi Feinan (Najjar et al. 1990), and Sha`ar Hagolan (Alperson and Garfinkel 2002).

The biggest change in the PN is the addition of ceramic vessels to the archaeological assemblage. "From the PN onward, pottery becomes one of the major tools of the archaeologist for defining geographic sphere, chronological developments, and correlations of ancient cultures" (Mazar 1992:49). The importance of pottery to the archaeological record can not be overstated, but it is too large a subject to be covered in this thesis. While this is the first period ceramic vessels became common, PN assemblages contain both fine ware and coarse ware, indicating some time and energy was put into the production of some pieces. At both Yarmoukian and Jericho IX sites a large variety of vessel forms have been studied. There were too many vessel forms to be examined within the scope of this study, but a brief look at the possible vessel functions may be indicative of the needs of those practising rudimentary agriculture.

An analysis of the Yarmoukian ceramic material recovered at Sha`ar Hagolan divided the vessels into four functional categories (Eirikh-Rose and Garfinkel 2002:101). Regardless of the differences between the Yarmoukian and Jericho IX ceramic assemblages, the functional categories are general enough to be applied to both. The four categories are storage, hot and cold food processing, serving, and valuable materials preparation, such as cosmetics, spices, or medicines (Eirikh-Rose and Garfinkel 2002:101). At Sha`ar Hagolan, the highest percentage of vessels are classified as serving vessels (40.2%), followed by food preparation vessels (30.4%), then storage vessels (22%), and finally valuable materials preparation (4.4%). Vessel types from the range of the functional categories were uncovered in each building, indicating the buildings covered a full range of domestic activities, including the special preparation vessels (Eirikh-Rose and Garfinkel 2002:101). The vessel functions are too general to specify what types of food or liquids were being processed, stored and consumed. However, they do indicate that the function of the vessels was tied directly to the subsistence economy.

The subsistence economy of the early PN is a mixture of agriculture, animal husbandry and a small amount of hunting. The floral, faunal, and lithic evidence is limited at most sites, but taken together forms a general picture. The majority of the evidence comes from Yarmoukian deposits. Whether this is indicative of differences with the Jericho IX deposits or just a lack of evidence is unknown. I am inclined to believe there is just a lack of evidence, as pottery is prominent at both Yarmoukian and Jericho IX sites and the vessel functions of the ceramic industry appear to be related to the subsistence economy.

2.2.3. Summary

With respect to the Neolithic of the Levant there are three geographical areas to consider, but all of the sites examined in this thesis are located in the Southern Levant. The Northern and Southern Levant appear to have had similar subsistence economies, with notable exceptions. In the North, sheep were the predominant pastoral animal, not goats. Sheep can graze on fallow fields and are not damaging to an arboreal environment (Köhler-Rollefson 1988:91-92). The terrain in the North is more suited to sheep as topographically it is primarily flat, whereas the

South is more varied, with deep wadis and irregular terrain. Goats survived well in the latter. One more difference between the North and the South is the use of gypsum plaster as opposed to lime plaster. Gypsum plaster requires less fuel than lime plaster in its production (Rollefson 1996:225). The Northern and Southern Levantine Neolithic populations adapted to their environments with similar mixed economies, but with varying results. Both the Southern and Northern Levant showed dramatic settlement pattern changes and widespread desertion of sites. Overexploitation was common to both areas, but the adoption of goats as a primary source of subsistence and the heavy use of lime plaster may have made the recovery of the catchment areas in the South impossible.

‘Ain Ghazal was not deserted prior to the PN, as Beidha, Basta and Jericho were, but the settlement did undergo socioeconomic changes and was abandoned during the PN. The socioeconomic responses to the environment are considered the causes for the abandonment of PPN sites in the Southern Levant and the changes observed at ‘Ain Ghazal. The excavators considered the adoption of goat husbandry by the residents of ‘Ain Ghazal as an “ingenious response to the gradual depletion of game...an ideal answer to the growing scarcity of faunal resources” (Köhler-Rollefson and Rollefson 1990:11-12). The population of ‘Ain Ghazal increased rapidly for the first 500 years, doubled again by 6250 B.C., levelled off in the PPNC and in the Yarmoukian period began to decline (Köhler-Rollefson and Rollefson 1990:7-8). As the human population decreased the domestic goat population increased (Köhler-Rollefson and Rollefson 1990:6). The excavators have calculated that by the PPNC the goat herds must have spent much of the year away from the main settlement, along with a portion of the human population (Köhler-Rollefson and Rollefson 1990:11). Eventually sites in the Southern Levant such as ‘Ain Ghazal were deserted in favour of “small agricultural communities...who traded their resources with pastoral nomads” (Köhler-Rollefson and Rollefson 1990:11). The abandonment of PPN sites and later PN sites, combined with the change in settlement patterns for the Southern Levant, is primarily attributed to human mismanagement of resources.

It is likely that the sites that remained inhabited throughout the PPN had better adaptive responses to their environment. Henry (1989) argues that in the Natufian Period the adaptive responses to the drier conditions and subsequent decline of storable resources allowed some

settlements to survive while others failed. “Alternative adaptive responses to a common climatic change were therefore dictated by the local environmental expressions of that change” (Henry 1989:29). In the PPN, the settlements that remained occupied adopted a new subsistence strategy in which goat played a primary role. The PN settlements continued with the mixed economy begun in the PPN and with the creation of a ceramic industry the ability to store resources increased.

2.3. Architecture of the Pre-Pottery Neolithic Period

The architecture associated with the PPN has been studied and analysed repeatedly (Byrd and Banning 1988; Banning and Byrd 1989; Banning 1996; Banning 1998; Byrd 2005; and Kuijt 2000) because of its distinctiveness and preservation. A review of PPN architecture is required to provide a comparison with PN architecture and the ensuing changes observed therein. Most of the PPN Levantine structures excavated are well-built, well-maintained, and extremely well-preserved, hence PPN architecture provides ample scope for this study. The general method of construction in the PPN was to level the ground, dig postholes and place posts, construct a rectangular wall with the double wall method, build a roof of beams with reeds and packed mud, then finish the floors and often the walls with painted plaster (Banning 2003:10-11).

2.3.1. Architecture of the Pre-Pottery Neolithic Periods: Construction Techniques and Layout

The construction techniques employed in the PPN required time, organisation and experience. Beidha, which was excavated with a particular focus on architectural remains, and Jericho provide evidence for the progression of construction techniques. Sites such as Basta, Khirbet Hammam, and Atlit-Yam demonstrate construction techniques for a single occupation period. All of these sites were deserted within the PPN. ‘Ain Ghazal and Yiftahel remained occupied into the PN, but only ‘Ain Ghazal has architectural remains associated with the PN. The construction techniques of the PPN at all of these sites indicate a stable socio-economic environment.

By the MPPNB, the layout of structures all over the Southern Levant was fairly consistent, with the structural design identified as the pier house being the most common. The building form is an open floor plan, with no rooms inaccessible from the main entrance. By the LPPNB, corridor buildings or multi-cellular buildings, sometimes with a courtyard in the centre and multiple rooms surrounding it become the common design layout. The compartmentalisation of rooms restricts access to outer rooms. A person would have to pass through the main entrance and more than one room to gain access to all areas of the building. The change from an open, accessible floor plan to a restricted or compartmentalised floor plan could be interpreted as a reflection of growing socio-economic pressures and will be discussed following the description of PPN architecture.

Since the evolution of architectural construction techniques in the PPNB is well attested at Beidha, the site will be used as a template for comparison with other sites. Beidha is the remains of an early Neolithic village in Jordan, about 5 km from the famous site of Petra. Beidha was excavated for eight seasons, seven between 1958 and 1967 and one final season in 1983 by Diana Kirkbride-Helbæk. The goal at Beidha was to uncover a broad horizontal exposure, and examine the plan of a Neolithic village along with the architecture of individual dwellings (Byrd 2005:5).

Kirkbride identified nine levels at PPNB Beidha, with Level I being closest to the surface. The Beidha Publication Project, which began in 1987, started with a stratigraphic analysis of the site as a whole. The final stratigraphic phasing, put forth by Byrd (2005), divides Neolithic Beidha into three phases (A, B, C) with some subphasing. Phase A is dated to the MPPNB and phase C to the LPPNB, with phase B falling somewhere within both the MPPNB and LPPNB. There is no break in occupation and the site is deserted in the LPPNB. The uncalibrated radiocarbon dates for all three phases range from $7,178 \pm 103$ B.C. to $6,596 \pm 100$ B.C., indicating a fairly short occupation period of 600 years (Byrd 2005:26-27).

The construction techniques and building layouts at Beidha changed a number of times during this 600 year occupation. The changing architecture of the PPN southern Levant is reflected within the phasing model proposed by Byrd (2005). But this model is considered the

“idealised representation of how the Neolithic village of Beidha changed over time” (Byrd 2005:12). Phase B architecture does not completely replace Phase A and Phase C does not eliminate Phase B construction. The structural designs were fluid, with one type of architecture gradually becoming dominant over that of the earlier phase. Because of the overlapping architectural phases at Beidha, it is not possible to present exact parallels with structures at other sites. Designs at other sites will be sorted into the Beidha phases as closely as possible.

The stratigraphy at Beidha is based on the architectural phases in combination with lithic, fauna, and floral deposits and sedimentary processes. Phase A (Kirkbride’s Levels V-IX) was subdivided into A1 and A2. Nineteen structures were uncovered in Phase A, the majority of which were either round or oval shaped (Byrd 2005:74). Kirkbride (1967) describes the architectural pattern as “honeycomb shaped”. The buildings were semi-subterranean and a post-socket style of construction was predominant in subphase A1, and only occasionally employed in subphase A2. The post-socket construction was implemented as follows: posts were positioned approximately 30-50 cm apart in a circular pattern and attached to a central post with cross beams. A two-course stone wall, primarily limestone, was built up against and outside of the posts, many of which show evidence of slots for the crossbeams. There is evidence for the use of mudbrick; in some instances it may have been used for the upper parts of the walls. The roof was composed of reeds, brush and clay. Plastering of the floors and walls with a sandy, clay mixture was common (Byrd 2005:74-77; Kirkbride 1967:6). The architecture of Jericho PPNA is similar to Phase A1 Beidha with semi-subterranean, circular walls of a “beehive shape” (Kenyon 1957:71). The primary building material was mudbrick, as opposed to stone, but wooden posts were also used (Kenyon 1985:26). Unlike Beidha, plaster was not used on the circular buildings at Jericho (Kenyon 1957:70).

In Phase A2, a new construction technique was introduced that continued throughout Beidha’s occupation. Rectangular slabs of mud stone (petrified clay deposited within Cambrian sandstone) were used, resulting in a more consistent style of construction (Figure 2.4). This new construction technique coincided with a decline in the use of timber (Byrd 2005:96). The layout of A2 structures remained a mixture of oval and round (Byrd 2005:75). Hearths began to appear within structures in subphase A2 (Byrd 2005:103). At MPPNB ‘Ain Ghazal a post and socket

construction technique, much like that of Beidha phase A1 and some of phase A2 was used (Banning 2003:10-11), with a corresponding decline in the use of timber, as seen in Beidha phase A2. Postholes within the MPPNB 'Ain Ghazal decreased in both size and number throughout the MPPNB (Rollefson et al. 1992:448).



Figure 2.4. Exterior face of Beidha subphase A2, rectangular slabs of mudstone (Byrd 2005:280). Reprinted with permission.

Phase B (Kirkbride's Level IV) is poorly preserved, as Phase C construction destroyed much of Phase B. The remains of 18 structures were uncovered. Many were oval shaped, but a subrectangular shape was introduced at the time as well (Byrd 2005:80). The majority of the structures were single-roomed, semi-subterranean, and most floors and walls were plastered (Kirkbride 1966b:18). The post-socket construction of Phase A1 was no longer used, while the flat stone construction introduced in Phase A2 was predominant in Phase B (Figure 2.4). Phase B also introduced the use of stone stairways leading down to the semi-subterranean floor (Byrd 2005: 82-83). Some structures of Beidha Phase B were plastered with a white, solid lime plaster, but many of the buildings were still plastered with a sandy, clay mixture containing some lime (Kirkbride 1966b:23). At Jericho, the PPNB was identified as the "Plaster Floor Phase" and the construction techniques were similar to Beidha Phase B, except the primary construction

material was mudbrick as opposed to stone (Kenyon 1957:55). The choice of material at sites in the Levant appears to be based on availability. As in Beidha Phase B, the buildings were rectangular with slightly rounded corners (subrectangular). The introduction of rectangular architecture in Phase B at Beidha was different from initial rectangular buildings at other sites, such as Jericho and 'Ain Ghazal. At Beidha, initial rectangular buildings were no larger than 9 m². At other sites, rectangular structures were bigger and internally subdivided. The large room in 'Ain Ghazal buildings averaged 22 m² (Byrd 2005:99; Byrd and Banning 1988:67). There is evidence for a break in occupation at Jericho prior to the PPNB rectangular buildings (Kenyon 1957:70).

The rectangular building commonly associated with the PPNB is the pier house, so designated by Banning and Byrd (1988). It is found at Jericho (Kenyon 1957), 'Ain Ghazal (Banning and Byrd 1987), Yiftahel (Braun 1997), and Beidha Phase C (Byrd 2005). The pier house is a rectangular hall subdivided by piers that run perpendicular to the long walls, sometimes with a space between the pier and the long wall. The piers are constructed of stone, mudbrick, or wooden posts, and not only subdivide the space within the structure, but act as supports for the roof (Figure 2.5). The entrance is located in one of the short sides (Byrd and Banning 1988:65-66).

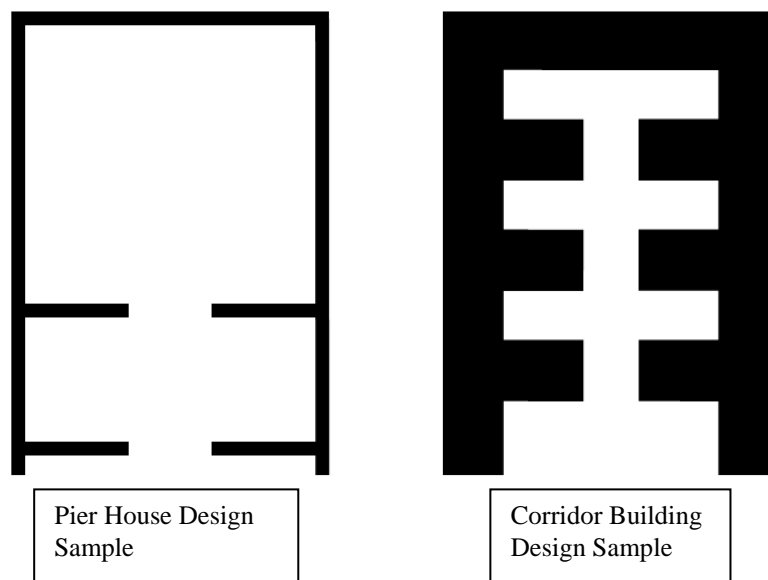


Figure 2.5. Building Design Samples (drawn by the author)

The stages of construction were determined for a MPPNB 'Ain Ghazal pier house. "First the floor had to be dug out and levelled. Then stone or mudbrick walls were constructed. Wooden posts were used to construct a frame, which was then filled in with stone and mud. Finally, the roof was laid and the walls were plastered." (Banning 2003:9) This construction method could have been used at MPPNB Jericho, Yiftahel, or Beidha. The floors of the 'Ain Ghazal pier house were heavily plastered with lime plaster curving up the walls, often painted red or cream. The walls were covered with a mud plaster, then lime plaster. It is unclear if the walls were painted (Banning and Byrd 1987:313-341). The same lime plaster technique, coloured red or cream, on the floors and walls is seen at Jericho (Kenyon 1957:55; Kenyon 1985:31). The shape of the Jericho PPNB house remained unchanged through some 25 refurbishings (Bartlett 1982:50).

Yiftahel, located northeast of Jericho, was continuously occupied from the MPPNB to the PN (Braun 1997:118). The MPPNB occupation at Yiftahel, Area C, is small but densely packed with buildings. The excavator estimates 3-4 structures per 1,000 sq. m (Garfinkel 1987:203). The remains of one complete structure were uncovered during a salvage excavation. The structure (700) is very large, composed of a rectangular room with a courtyard on each side, a tripartite plan (Garfinkel 1987:203). The walls are a fieldstone base, with a mudbrick superstructure. Both the floor and the walls have been coated in multiple layers of plaster. Garfinkel compares this structure with similar structures from PPNB Jericho (Garfinkel 1987:204-205).

Evidence for the LPPNB architecture is very limited at Yiftahel. No complete structures were uncovered, only a series of unconnected walls. The excavators compare the walls to modern Bedouin tent sites. The PPNC Yiftahel architecture is rectilinear, comparable to the pier house of MPPNB 'Ain Ghazal, PPNB Jericho and LPPNB Beidha. The excavators also compared the architecture to the corridor building of PPNC 'Ain Ghazal. Plaster is used in a limited capacity at PPNC Yiftahel (Braun 1997:119-120).

The final occupation at Beidha is Kirkbride's Levels I-III, Byrd's Phase C (Figure 2.6). Twenty-two buildings and two courtyard facilities were identified. Of the 22 buildings, 18 were categorised as medium sized (3.2-6.2 m) and all of these were a new type of structure, the



Figure 2.6. Plan of Phase C, Beidha. (Byrd 2005:192) Reprinted with permission.

corridor building (Figure 2.5) (Byrd 2005:85). The two largest buildings (8 and 9), however, were not corridor buildings, but were large pier houses. Building 9 was rectangular with curved interior corners. The larger room was almost square with a second smaller, rectangular room along the shorter southern wall. The smaller room may have been a courtyard (Byrd 2005:191). Building 8 was constructed after building 9 was destroyed by fire (Byrd 2005:56) and was the largest excavated at Beidha. Building 8 (Figure 2.6) was constructed overtop of building 9 and portions of corridor buildings 6 and 7. “It consisted of a large main room (~8.0 m by ~7.0 m) and

a long narrow secondary room (~4.5 m by originally ~8.0 m) on the south.” (Byrd 2005:67). The construction technique used for both of these buildings is the double wall method, two courses of large stones, with rubble or cobbles between them for stability (Byrd 2005:56; 68; Galili et al. 1993:139). These two buildings were heavily plastered, unlike the corridor buildings.

The double wall method of construction became quite common throughout the southern Levant in the PPNB and continued into later periods. At PPN sites that have limited architectural exposure, the double wall method is sometimes the only structural consistency. The only complete feature excavated at PPNC Atlit-Yam was a well. However, the walls belonging to an incomplete structure at Atlit-Yam were at least 5 courses high and constructed in the double-wall method (Galili et al. 1993:139). The double-wall method was used at PPNB Wadi Shu'eib (Simmons et al. 2001), PPNB Beidha (Byrd 2005:56), and PPNC 'Ain Ghazal (Rollefson et al. 1992; Rollefson and Köhler-Rollefson 1993).

The corridor building from Beidha Phase C (Figure 2.7) is similar to the pier house in design, except the piers become more numerous and thicker. Therefore, the rooms within the structure were smaller and the open feel associated with the pier house design was gone. The corridor buildings excavated at Beidha were identified as two-storey structures. Only the basement has been preserved from which the term corridor building was derived (Byrd 2005:85). The corridor building was rectangular, with an entrance in one of the short walls, and six small rooms within. The rooms were divided by thick stone walls, with three rooms running parallel along each long wall. The walls separating the individual rooms, many of which are bigger than the rooms themselves, were necessary to support an upper storey (Kirkbride 1966a:203). The standard construction method was to first dig a pit, then the lower storey exterior walls were built flush with the pit floor, and finally the pier walls abutting the side walls were constructed. Large stone cobbles and blocks were the primary construction material for the basement walls (Byrd 2005:87). Although the use of plaster is considered an identifying trait of the PPNB, none of the walls in the corridor buildings was plastered and only two of the floors uncovered were possibly plastered (Byrd 2005:86).

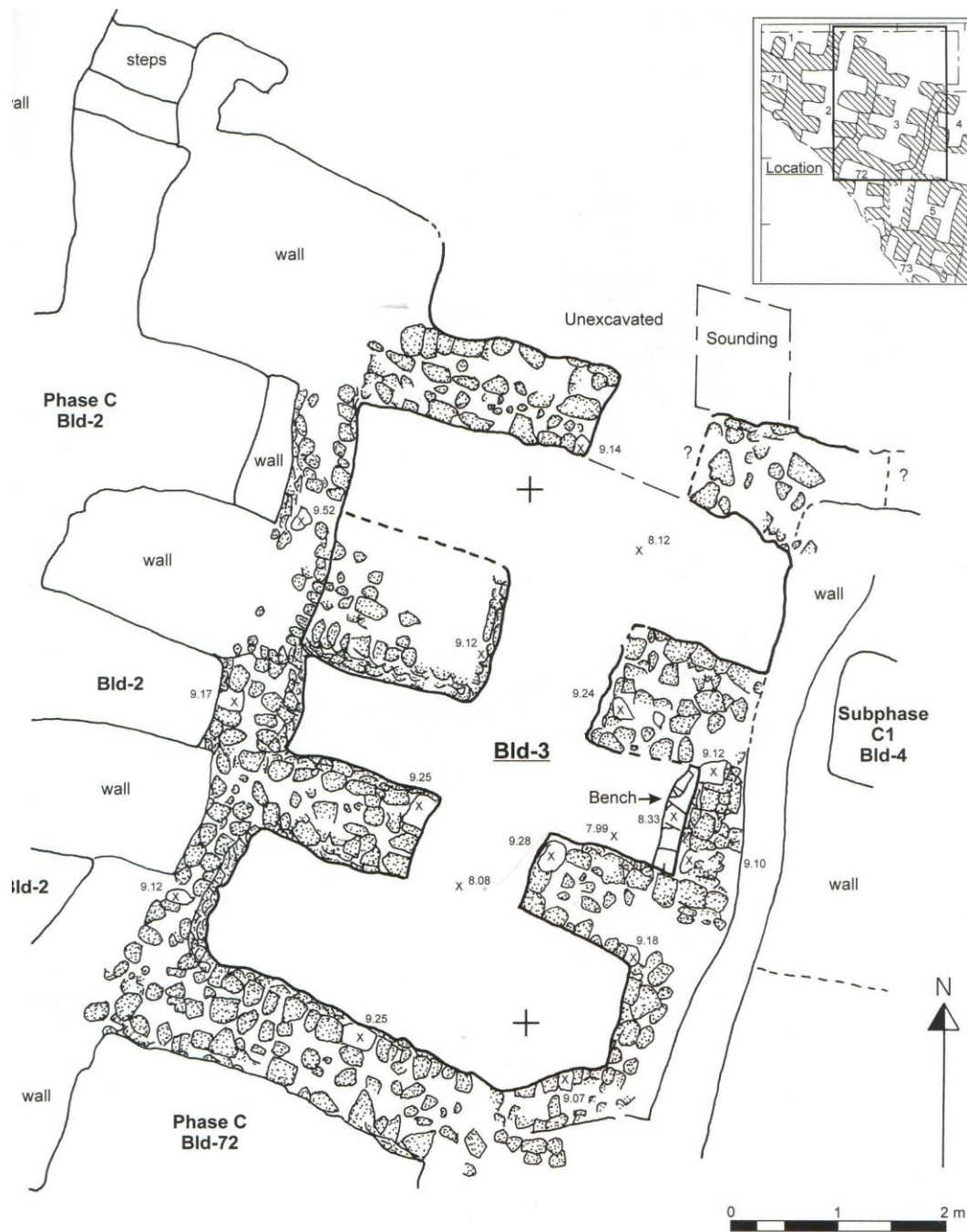


Figure 2.7. Plan of Corridor Building lower-storey, Phase C, Beidha. (Byrd 2005: 371). Reprinted with permission.

Kirkbride (1966b) identified one building and a number of walls as Level I. Level I is now considered to be the remains of the upper stories of the corridor buildings (Byrd 2005:93). All of the corridor buildings had subterranean basements (Figure 2.7, Bld-3), but many may have

been partially above ground. No complete upper-storey has been preserved; what remains is fragmentary, so the design of the upper-storey is conjectural. Byrd and Banning (1988) suggest that the upper-storey design was a pier house (Figure 2.4), which has been excavated at PPNB 'Ain Ghazal, Jericho and Yiftahel and elsewhere within Phase C Beidha. No upper-storey length is preserved and the width appears to be only slightly less than the lower-storey. There was some evidence of thin interior walls, possibly following the same pattern as the corridor level. Evidence for access between the upper and lower levels is also limited. There are no steps and only one doorway is preserved (Byrd 2005:88-89). At least four corridor buildings similar to Beidha Phase C have been uncovered at 'Ain Ghazal and are dated to the PPNC. All are semi-subterranean and there was no evidence of a second storey, but the remaining walls only reached a height of less than a metre (Rollefson and Köhler-Rollefson 1993:36-37). The double wall construction method was used and lime plaster floors from the PPNB were reused, but the walls show no evidence of plastering. The PPNC inhabitants did still manufacture plaster, but on a smaller scale (Rollefson et al. 1992:449; Rollefson and Köhler-Rollefson 1993:36-37).

In the LPPNB, another construction technique and building design, not seen at Beidha is observed at other sites. Basta is a LPPNB site at least 10 ha in size located less than 20 km southeast of Beidha, in modern Jordan (Figure 1.1). The settlement of Basta was constructed on a steep slope, leading to an interesting architectural development. In Basta Area A, a network of stone channels about 15-30 cm wide and 60-120 cm deep, capped with stone slabs, was constructed underneath more than one floor. Although the channels vary in depth, the cap stones are level. The channels were constructed to level the floors on the slope and keep the structures off the wet ground (Gebel et al. 1988:116; Nissen et al. 1991:13-14).

The complex in Basta Area A above the channels is composed of over thirty rooms of varying sizes, all sharing walls (Nissen et al. 1987:86). The walls are constructed of limestone, available locally, with small chinking stones used as mortar. The rooms appear to be laid out in a haphazard manner (Gebel et al. 1988:116; Nissen et al. 1987:94). In Basta Area B, the layout of another complex appears more planned and organised. At least 6 courtyards have been identified, all surrounded by small adjoining rooms. Like Area A, all the walls are shared, giving the appearance of a single unit (Nissen et al. 1991:16). The walls are constructed of dressed,

rectangular limestone slabs often laid in lime-mortar (Nissen et al. 1987:88). Floors were well plastered, with some evidence of red paint. In some places the floor plaster curved up the wall, so it is possible the walls were plastered as well (Gebel et al. 1988:110). Since Basta was only occupied during one period, the LPPNB, an evolution in architectural techniques is not observed. The large complexes combined with the planning and building of channels prior to the construction of Area A indicates an organised community with prior experience in large scale construction.

Khirbet Hammam is located about halfway between 'Ain Ghazal and Beidha and dated to the LPPNB. The extremely limited excavation revealed the corner of one structure and the wall of another, later structure. The earlier structure was built with shaped and faced stone and mud plaster; the interior walls were lime plastered. A later structure, abutting the first, was not as sturdily constructed. The interior wall surface and floor was lime plastered, some of which may have been painted red, common to all the PPNB sites discussed. Below the floor was a layer of cobbles, allowing for a level foundation. Underneath the cobbles was a possible channel (Peterson 2004:7). The use of channels under the floor is similar to the construction technique observed at LPPNB Basta (Gebel et al. 1988:116; Nissen et al. 1991:13-14).

The typical LPPNB structure followed a similar pattern of construction as MPPNB, but the corners were sharp, and the use of timber was extremely limited. Rooms became smaller. The use of lime plaster was not as consistent as during the MPPNB. While Basta was well plastered (Gebel et al. 1988), the corridor buildings of Beidha were not plastered. In contrast, the large non-subterranean buildings at Beidha were heavily plastered (Byrd 2005). Wadi Shu'eib and Khirbet Hammam both used lime plaster in the LPPNB (Peterson 2004; Simmons et al. 2001), while 'Ain Ghazal had limited evidence of the use of plaster (Rollefson et al. 1992), and Yiftahel showed no evidence of plaster use in the LPPNB (Braun 1997). The dwindling use of timber and lime plaster has been attributed to the overexploitation of local wood resources. In particular, the amount of wood required to create quicklime was extensive. Approximately four tons of wood produced one ton of quicklime and the average PPNB house used 3.3 metric tons of quicklime (Rollefson and Köhler-Rollefson 1989:76-77).

There is only a limited sample of architecture for the PPNC, 'Ain Ghazal being the primary site. A combination of the MPPNB single roomed building and the increasing compartmentalisation of the LPPNB is observed in the PPNC. The same corridor building from LPPNB Beidha Phase C (Byrd 2005) was found at PPNC 'Ain Ghazal. Again, there is no evidence of an upper storey. Buildings were not lime plastered, but inhabitants did reuse PPNB plaster floors (Rollefson and Köhler-Rollefson 1993). Both PPNC Yiftahel and Atlit-Yam had evidence of limited plaster use (Braun 1997; Galili et al. 1993). The double wall method of construction was used at both 'Ain Ghazal and Yiftahel.

The progression of structural design and building technique used in PPN architecture, particularly at Beidha, was fluid. A construction technique and design would become dominant, and then a new design would evolve to dominate the site. Since there were no breaks in occupation at Beidha, the assumption is that Beidha supported and maintained a stable population base for hundreds of years before the site was abandoned. The evolution of the architecture appears to occur naturally, with no sudden or dramatic changes.

The inhabitants were clearly skilled and planning to live in the houses they constructed for a significant amount of time. For example, a PPNB structure at Jericho went through 25 refurbishings (Bartlett 1982:50). The construction techniques employed took time, organisation, and experience, indicating the builders were working within a stable social and economic environment. This is particularly evident in the MPPNB when the pier house was the dominant architectural style of the Southern Levant.

The corridor buildings and multi-cellular courtyard buildings appear in the LPPNB and PPNC periods of the Southern Levant, prior to sites being abandoned. Kuijt (2000) examined the five largest sites from each period in the PPN and observed an increase in settlement size, combined with an increase in compartmentalisation (Figure 2.8). The four periods examined were the Late Natufian, PPNA, MPPNB, and the LPPNB. Examination of the PPNC was attempted, but not enough information was available. For each period the largest sites, determined by site area, depth of cultural deposits, estimated population levels, and current available data, were studied.

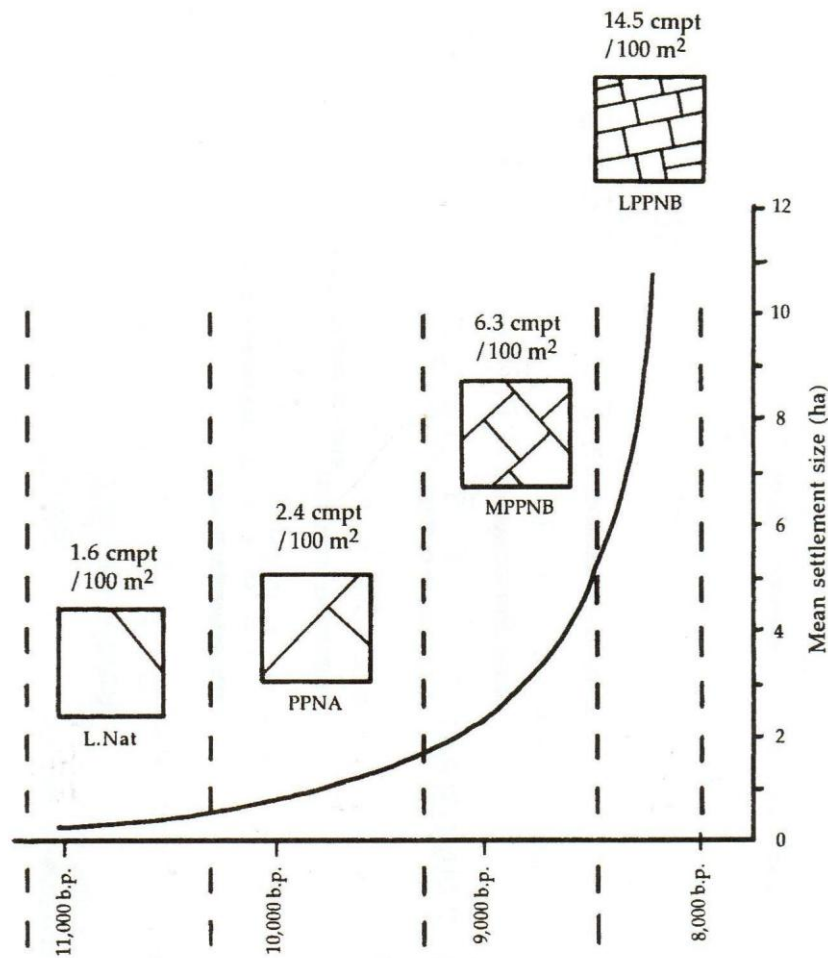


Figure 2.8. Settlement size increase and mean compartmentalization of Levantine settlements (Kuijt 2000:83). Reprinted with permission.

Although sites increase in overall size towards the end of the PPN, the structures were more internally divided. The number of rooms increased, but the overall size of the structures remained the same. Kuijt calculated a 4500% increase in site size from the PPNA to the LPPNB and an increase from 2.4 compartments/100 m² to 14.5 compartments/100 m² over the same time periods (Table 2.3). The increased compartmentalisation “reflects the increased stress of social crowding and desire to delineate space for privacy, or growing emphasis on personal goods or ownership, or most likely, a combination of these and other factors” (Kuijt 2000:89).

Table 2.3. Estimated Increases in Site Size, Population Levels and Compartmentalization for Late Natufian through PPNC Period Settlements in the Mediterranean Zone of the South-Central Levant (Kuijt 2000:85). Reprinted with Permission.

Period	Estimated mean site size (ha)	Estimated % increase in site size	Estimated mean population (van Beek 1982)	Estimated mean compartmentalization (mean from Table 3)
Late Natufian (11,000–10,300 B.P.)	0.2	—	59	1.6 compartments/ 100 m ²
PPNA (10,300–9,300 B.P.)	1.0	500%	332	2.4 compartments/ 100 m ²
MPPNB (9,300–8,500 B.P.)	3.0	1500%	764	6.4 compartments/ 100 m ²
LPPNB (8,500–8,000 B.P.)	10.0	5000%	3293	14.5 compartments/ 100 m ²
PPNC (c.8,000–7,750 B.P.)	12.0 (?)	6000% (?)	3822 (?)	unclear

“Architecture fulfills a variety of social demands ranging from mundane aspects such as shelter to regulating social interaction within a community” (Byrd 1994:643). The increased compartmentalization at LPPNB sites was likely a result of a number of factors, including the physical need for space for an increased population and the changing social needs of that same population. Beyond the need for more space for more people, the increased compartmentalization could also reflect changes at the household level. Households could now be performing more activities inside specific rooms within the house and storing more items, where neighbours could not see or easily access (Banning 1997:47). The need for these changes at the household and community level were likely varied, but what is certain is that the LPPNB Southern Levantine communities grew in both size and population, leading to increased compartmentalization before being abandoned.

2.3.2. Architecture of the Pre-Pottery Neolithic Period: Use

Building function in the PPN is sorted by some archaeologists into three general categories: domestic, nondomestic and storage (Byrd 2005). Identifying building function is limited by a number of factors. Building functions can change over time and the evidence left behind may be a mixture of different functions or the only remnants recovered may be from the final use of the building. The selective preservation of materials over time and the manner in

which a structure was abandoned determine what is left behind for archaeologists to interpret (Byrd 2005:114). For example a catastrophic event such as fire may preserve a snapshot in time, but those events are rare and still only part of the snapshot survives to be recovered. The criteria used at Beidha to classify structures were as follows. Storage structures had to be small and lack features or artifacts that indicated other functions and include artifacts that could function as containers. Nondomestic structures were also primarily defined by negative evidence, the lack of evidence of domestic activities and unique construction or layout different from domestic buildings (Byrd 2005:114). Domestic activities were considered “eating, food processing, equipment production, storage, and sleeping”, and any features or artifacts associated with these activities indicated a domestic structure (Byrd 2005:114).

Another problem with building identification is the methodology used by Near Eastern archaeologists. At Beidha, Byrd (2005) acknowledges that there may be “an overrepresentation of generalized domestic dwellings, since unless there was sufficient evidence to the contrary, buildings were typically interpreted as domestic structures” (Byrd 2005:114-115). Although other excavators have not explicitly acknowledged this bias, excavation reports typically describe structures as domestic unless there is a clear reason for describing them as something else.

The structures at Beidha have been classified by size, function and phase. Out of 63 structures only 11 were identified as nondomestic (ritual activities), and 7 of the nondomestic buildings were the largest structures at Beidha (Byrd 2005:115). Medium buildings ranged from 5.8 to 21 m² and are the most common structure found during all three phases at Beidha, 83% of which were classified as domestic (Byrd 2005:113-115). They were identified by the presence of portable and/or nonportable artifacts and features, particularly hearths and stone platforms (Byrd 2005:117). In situ portable or nonportable artifacts associated with processing and production was considered identifying factors for domestic activity (Byrd 2005:117).

The activities within the domestic structures appear to remain consistent throughout the occupational phases at Beidha. Due to the selective preservation of materials over time, our knowledge of activities within structures is limited. Within the domestic structures of Phases A,

B, and C is evidence for food preparation, the manufacture of artifacts, and the storage of food and raw materials (Byrd 2005:115-117). The only difference between the occupational phases is that there are no hearths associated with Phase C domestic structures, so cooking did not take place within those rooms. The Phase C structures (corridor buildings) are all considered to be the basement levels of the structures. It is assumed that the hearths were located on the main level and activities such as cooking, eating and sleeping occurred on the main level (Byrd 2005:117). By Phase C, it would seem that although the activities themselves remained the same they took place within a more strictly defined area that was not readily accessible to everyone.

The most common type of building uncovered during the PPN is the pier house. At Jericho (Kenyon 1957), 'Ain Ghazal (Banning and Byrd 1987), Yiftahel (Braun 1997) and Beidha (Byrd 2005) the pier house is always identified as a domestic structure. The complexes at Basta are also identified as domestic and using Beidha's classification system as a template, artifacts associated with domestic activities were found within both Basta complexes (Nissen et al 1987). The association of specific functions with specific rooms within the complexes has not been published. As with the majority of Near Eastern excavation reports the artifacts are described separately from the architecture. In the case of Basta artifacts are described and analysed in terms of what area of the site they were found in (Area A, B, C). Whether within or outside of structures is not stated. The artifacts are then compared as a whole to other sites with similar archaeological assemblages from the same time period.

Most PPN structures have been identified as domestic structures, in part as a result of archaeological bias, but primarily because activities such as the processing of food and the manufacturing of products had not yet moved beyond a household level. When structures were single roomed during the first half of the PPN, activities occurred within the room and, most likely in open areas around the sites. As structures became more complex with subdivisions toward the end of the PPN, it is possible that internal functions became more pronounced and activity areas more restricted, as discussed in the previous section. Unfortunately, the archaeological evidence for internal function is limited due to the selective preservation of materials over time and in general very few sudden events, such as fire, caused abrupt abandonment of structures and the artifacts within them.

2.4. Architecture of the Pottery Neolithic Period

The introduction of pottery to the Levant was accompanied by a number of changes in the region. Some sites were deserted following the PPNB, such as Beidha, Basta, and Khirbet Hammam. Jericho was abandoned in the PPNB, but resettled in the PN. Atlit-Yam was only occupied in the PPNC. 'Ain Ghazal, Wadi Shu'eib and Yiftahel had a continuous occupation from the PPN to the PN. The population movements that must have accompanied the varying settlement patterns were accompanied by changes in architecture, lithics, and economy. The well-built, well-maintained architecture of the PPNB is rare in the PN, which exhibits a wide variety of building techniques and forms. The development of structural design and building technique observed at Beidha is no longer apparent in the PN.

2.4.1. Architecture of the Pottery Neolithic Period: Construction Techniques and Layout

2.4.1.1. Yarmoukian Sites

Yarmoukian occupations are more numerous and substantial than Jericho IX settlements. The Yarmoukian type site, Sha'ar Hagolan, was the largest and most developed Pottery Neolithic settlement. Excavation at Sha'ar Hagolan was designed to focus on the PN, something the excavators felt was lacking at other sites containing PN remains, where the PN was just one of the occupation levels being excavated. The Yarmoukian material is well preserved, probably because it was not buried under later occupation layers, as at other sites. The excavation project was designed to uncover a substantial horizontal exposure, over an extended period of time (more than 10 years), with a large research team including a number of specialists and technologies such as petrographic analysis of pottery, the use of medical computed tomography on ceramic figurines, and paleoethnobotany (Garfinkel and Miller 2002a).

The Yarmoukian buildings at Sha'ar Hagolan are constructed of locally available materials, namely basalt cobbles from the nearby Yarmuk River and mudbrick from the local clay of the Lisan Formation. Most of the walls were constructed on the surface, on a stone

foundation composed of rounded or flat pebbles of medium to large size, with a mudbrick superstructure. There were no foundation trenches uncovered. The mudbricks used in construction were plano-convex in shape (loaf shaped round bricks). Wall width corresponded to architectural function; exterior surrounding walls are thick, while internal partition walls were often only one course wide. There was no evidence for the use of perishable materials, such as wood, and no evidence of post-holes. A range of floor types were uncovered, including paving with large, flat river pebbles, mud plaster, cobbled surfaces using small, angular stones, hard-packed earth, and one small area paved with crushed lime (Garfinkel and Ben-Shlomo 2002a:56-57).

The excavated Yarmoukian buildings, Building Complex I (Figure 2.9) and Building Complexes II and III, were all uncovered in Area E (Figure 2.10) where excavations were focussed at Sha`ar Hagolan. Of the three substantial courtyard buildings, Complex I (Figure 2.9) and Complex II were completely uncovered and Complexes III was partially excavated. The



Figure 2.9. Sha`ar Hagolan Building Complex I (Garfinkel and Ben-Shlomo 2002a:57). Reprinted with permission.

layout of the courtyard buildings was composed of a large, enclosed courtyard, with rooms of various sizes surrounding and opening onto the courtyard. The courtyard is the largest part of the

structure, encompassing 40-50% of the usable area of the building (Garfinkel and Ben-Shlomo 2002b:76). Complex I (Figure 2.9) contained 8 closed rooms and an open courtyard IA, measuring 233 square metres (Garfinkel 2010:36). The rooms surrounding the courtyard of Complex I were mainly built in pairs “one room unpaved with an entrance towards the courtyard, the other paved, without an entrance” (Garfinkel and Ben-Shlomo 2002a:69).

Figure 2.10. Sha`ar Hagolan Area E (Garfinkel and Ben-Shlomo 2002b:19). Reprinted with permission.

community planning and organisation (Garfinkel and Ben-Shlomo 2002a:69). There has been nothing comparable to the courtyard buildings at Sha`ar Hagolan found at other PN sites, be they Yarmoukian or Jericho IX settlements.

None of the planning and organisation seen at Sha`ar Hagolan was observed at 'Ain Ghazal. The Yarmoukian occupation at 'Ain Ghazal covered a larger area than any of the other Neolithic assemblages excavated at the site, but the fewest number of structures was associated with the Yarmoukian settlement. Unlike at Sha`ar Hagolan, there was no recognisable domestic type structure similar to the PPNB pier house excavated at numerous sites. The Yarmoukian population reused PPNB and PPNC walls and floors. Rectangular, apsidal and possible pit dwellings were uncovered, and many stone wall enclosures of indeterminate use were found (Kafafi 1993; Rollefson et al. 1992; Rollefson 1993).

The rectangular structures were built directly above the PPNC occupation. In the South Field one building had two rooms or a room and a courtyard. The floors were beaten earth and the walls were composed of medium boulders (Kafafi 1993:108). Two of the PPNC corridor buildings in the South Field show evidence of reuse in the Yarmoukian period, including new wall fragments and repairs. Porch-like extension walls were added to one of the corridor buildings, creating a courtyard-like area (Rollefson 1993:92). In the Central Field, a possible PPNC corridor building was again modified. New walls were added. They were not substantial, mainly one stone thick. Undoubtedly they served as partition walls rather than support walls. To the north of the many walls within the building is an open area, with three floor layers and Yarmoukian pottery found on the final surface (Rollefson 1993:92-94). Although none of these structures looks like the courtyard buildings discovered at Sha`ar Hagolan, a common feature seems to be a large open, often outdoor area, with rooms attached.

There was one building at 'Ain Ghazal whose walls were all built during the Yarmoukian period, an apsidal structure (Figure 2.11). Although the walls were built during the Yarmoukian period, the plaster floor was constructed in the LPPNB and reused. The structure was semi-subterranean, with stone walls and an apse at one end. The curved south wall or apse had a large monolith in the centre. The entrance was in the north wall, which was the longest wall, with steps

leading down into the building. This was the only building which reused an earlier plaster floor. The apsidal structure appears to have had a special purpose, since the only Yarmoukian pottery associated with the building is fineware. A second apsidal structure was excavated in the same area (Kafafi 1993; Rollefson et al. 1992).



Figure 2.11. 'Ain Ghazal Yarmoukian apsidal structure. (Rollefson et al. 1992:453). Copyright 2010 by Maney Publishing www.maney.co.uk/journals/jfa and www.ingentaconnect.com/content/maney/jfa. Reprinted with permission.

'Ain Ghazal also may have had pit dwellings. Many large pits were found associated with the Yarmoukian occupation, but none of them were fully excavated. Therefore, there is no clear evidence of the pits being used as abodes. The other structures found at 'Ain Ghazal were a

number of stone-wall enclosures, interpreted as either shaded plazas or the support for tent posts (Kafafi 1993:108; Rollefson et al. 1992:452). As the area was badly disturbed, identifying postholes was difficult.

Jebel Abu Thawwab is a PN and Early Bronze I site located north of 'Ain Ghazal in Jordan. The Yarmoukian architecture is stone built and the structures are round, apsidal and rectangular shaped. The floors are hard-packed earth or cobblestone. Once again a number of pits were associated with the Yarmoukian remains. At least one wall was constructed with the double wall method; some were a single row of boulders, and others were constructed of stones of different sizes. All of the walls used natural, unshaped stones (Kafafi 1985a, 1986, 1988, 1993).

A possible apsidal structure, similar to the ones uncovered at 'Ain Ghazal, has been tentatively identified at Abu Thawwab. The remains are a stand-alone curved wall with two postholes at the edges of the wall. It is assumed that the rest of the structure was composed of perishable materials (Kafafi 1993:108). Another architectural feature is a 15 m long wall, constructed with the double wall method, running north-south and built against an east-west wall (Kafafi 1985a:34; 1985b:125). The function of this feature is unknown, but may be similar to the stone-wall enclosures seen at in 'Ain Ghazal.

Five round structures and over 70 pits were uncovered within the Yarmoukian occupation at Munhata (Garfinkel 1993:128). Wadi Shu'eib and Tell Wadi Feinan both have Yarmoukian remains, but no complete structures were uncovered. Both sites do have straight walls and many pits. The pits at Wadi Shu'eib were interpreted as dwelling pits (Kafafi 1993:104). The excavations at 'Ain Rahub did not reveal any architectural remains, "only a lens of decayed mud bricks" (Kafafi 1993:102).

There is no standard building type in the Yarmoukian assemblage comparable to the pier house of the PPNB. With the exception of Sha'ar Hagolan there is not even a standard design within individual sites. The excavations at both 'Ain Ghazal and Jebel Abu Thawwab have uncovered three building designs during the Yarmoukian occupation. The only possible common

theme at Yarmoukian sites is large open areas in the form of courtyards and stone-wall enclosures.

2.4.1.2. Jericho IX

There is a limited amount of architectural evidence associated with the Jericho IX assemblages, including the type site of Jericho. Of the two excavations at Jericho, Garstang's Jericho IX and Kenyon's renamed PNA, only Kenyon's excavations recovered architectural evidence. No structures were found in association with the identified floors (Kenyon 1985:43). Wall stubs from the earlier PPN occupation at Jericho would have been visible during the Jericho IX occupation, but they do not seem to have been used, as Jericho IX dirt floors are sometimes below the wall stubs and sometimes run irregularly across the stubs (Kenyon 1957:81).

Kenyon's (1985) excavations also uncovered many pits that "literally honeycomb the mound wherever it has been excavated" (Kenyon 1985:43). The initial interpretation of the function of the pits is that they were quarry pits for mudbrick, but if so what were the inhabitants building? Within the pits were a number of floors and the pit walls were revetted with pisé (solid beaten earth) or stone, creating pit-dwellings. The high number of pits, both for dwellings and those filled with debris, in particular pottery, indicate a large population living at Jericho (Kenyon 1985:46).

The next layer of occupation, the Pottery Neolithic B (PNB) or Jericho VIII did build above ground, free-standing structures. Buildings were rectilinear with stone foundations and mudbrick superstructures. The bricks were hand-made and plano-convex in shape (Kenyon 1985:46), the same as the mudbricks found at Sha`ar Hagolan (Garfinkel and Ben-Shlomo 2002a:56). Kenyon (1985) compares the Jericho VIII pottery to the pottery recovered during Stekelis' excavations at Sha`ar Hagolan. Kenyon argued that the two sites "are related but not of identical composition" (Kenyon 1985:48). As more excavations were conducted, the prevailing theories are that Jericho IX and Yarmoukian are contemporary or that Yarmoukian is earlier than Jericho IX (Garfinkel 1999:10). Thus Kenyon's comparisons between Jericho VIII and Sha`ar Hagolan are problematic.

The pit dwellings with revetted walls at Jericho are comparable to the pits excavated at Dhra`. The walls of the pits at Dhra` are composed of hard yellowish clay, revetted with mudbrick (Bennett 1980:36). Further excavation revealed built structures above ground. Three rectangular buildings, a stone bin, plaster-lined pits and terrace walls were uncovered (Kuijt et al. 2007:109). The rectangular buildings were constructed with the double wall method, also seen at Jebel Abu Thawwab.

Dhra` is the first PN site known archaeologically with terrace walls. The terrace walls were perpendicular to the slope, and often bedrock outcrops were used as anchors. A foundation trench was dug, then one row of large limestone boulders were placed in the trench with small stones used to fill the empty spaces in-between the boulders. The upper part of the wall was constructed with small cobbles and mud infill. The terrace walls were slightly curved, which the excavator interpreted as necessary for stability when colluvial and alluvial build-up occurred behind the wall (Kuijt et al. 2007:111-112).

Architecture associated with Jericho IX occupations is scarce; no sites have been excavated with architecture equivalent to that of Sha`ar Hagolan. Mudbrick, semi-subterranean circular structures and pits were uncovered at Lod (Gopher 1995:210). As mentioned above, Wadi Shu`eib had straight walls and possible dwelling pits (Kafafi 1993:104). Both Yarmoukian and Jericho IX ceramics have been identified at Wadi Shu`eib (Simmons et al. 2001:22). Nizzanim and Givat Haparsa did not have structures, but pits, hearths and the bases of huts were uncovered (Gopher and Gophna 1993:322).

2.5. Wadi ath-Thamad Site 40 and Site 104

In 1998, Dr. C.M. Foley became the survey director of the Wadi ath-Thamad Project directed by Dr. Michele Daviau of Wilfrid Laurier University, Canada. From 1998 to 2001 six Neolithic sites were identified to the southwest of Khirbat al-Mudayna, the primary excavation site. The six Neolithic sites, WT-40, WT-95, WT-96, WT-97, WT-104, and WT-105 were identified separately, but “represent different spatial components of one large, continuous area of

Neolithic occupation” (Foley et al. 2004:1). In 2001, surface surveys of WT-40 and WT-96 motivated the survey team to excavate seven test probes between the two sites (Cropper 2002). In 2004, a salvage excavation of WT-104 and WT-40 was conducted by the Wadi ath-Thamad survey team when a nearby Bedouin camp’s agricultural activities cut through WT-40 (Dunn 2006).

WT-40 is located on the west bank of the Wadi ath-Thamad, on an alluvial terrace above a spring located on the eastern embankment of the wadi. WT-104 is also situated on the terrace, west of WT-40 where the terrace is eroding away to the limestone bedrock (Foley et al. 2004:3-4). The goals of the excavation of WT-104 and WT-40 in 2004 were to confirm the results of earlier test probes and to salvage a sample of data before agricultural activities and erosion continued to damage the sites. Five 6 m X 6 m squares were opened, two at WT-104 and three at WT-40. The course of excavation in each square was determined by stratigraphy and anthropogenic material; two 1 m baulks were left unexcavated in each square (Foley et al. 2004:5).

Site WT-104 revealed several architectural features, but due to erosion, very few artefacts, ecofacts, or stratigraphy. The surface survey identified 22 features, including circular structures and possible terracing walls (Foley et al. 2004:8-9). Squares C64 and C75 were opened around Feature 5, a large curving wall fragment that could be part of an oval structure approximately 24 m in diameter. If it was the remains of an oval structure it may have been an animal corral. Alternatively it could have been a terrace wall (Foley et al. 2004:6). Two ovoid features consisting of one row and one course of fieldstones in a semicircular configuration were also identified at WT-104. They were interpreted as temporary habitation, perhaps a lean-to structure or wind break (Foley et al. 2004:7). Site WT-40 provided a much richer deposit of archaeological materials. Several features, a burial, over 30,000 lithics, faunal material, and an extensive ceramic assemblage were uncovered during the single excavation season. The pottery and lithics collected in the initial survey and test units were documented in Dawn Cropper’s M.A. thesis, but only 47 sherds were recovered (Cropper 2002). The ceramics recovered during the 2004 excavation season were analysed and documented in Carrie Dunn’s M.A. thesis (Dunn

2006). As ceramic assemblages are the primary means of identifying Pottery Neolithic occupations, this study was important in the identification of Wadi ath-Thamad as a PN site.

The pottery from the initial survey and test squares is similar to other LN sites, both Yarmoukian and Jericho IX (Cropper 2002:91). The analysis of the assemblage from the 2004 excavations confirmed this original assessment. The WT-40 ceramic ware has typological and technological similarities to both the Yarmoukian and Jericho IX ceramic assemblages. The stylistic characteristics of WT-40 are more closely identified with the Yarmoukian assemblage from Sha`ar Hagolan, but the Jericho Stratum IX assemblage has not been analysed and published (Dunn 2006:88). Dunn has concluded that WT-40 “appears to belong to a regional subculture within the same cultural group as the typically defined Yarmoukian and Jericho IX typologies” (Dunn 2006:89).

2.5.1. Architecture of WT-Site 40: Construction Techniques and Layout

Five 6 X 6 m squares with two 1 m baulks in two sites, Site 40 and Site 104, were excavated for one six week season in 2004. A quick, but detailed description of the architecture will be given prior to examining the place of WT-40 in comparison to other Levantine PN sites. The architecture uncovered was recorded and measured using a pre-determined recording system, for consistency. The system of measurements used is as follows: a pebble is 0.2-6 cm, cobble is 6-25 cm, a small boulder is 25-50 cm, a medium boulder is 50-75 cm, a large boulder is 75-100 cm and a very large boulder is greater than 1 m. The description below follows this set of terms.

2.5.2. Site 40-Square 47 (Figure 2.12)

Square A47 was the eastern square and was chosen for excavation because a bulldozer cut revealed a possible pit. There were two curved walls, wall A47:5 and A47:8. Wall A47:5 was constructed of two rows of unfaced, small to medium limestone boulders with a cobble fill (the

double wall method of construction). Wall A47:8 was constructed of one or two rows of unfaced, upright, flat, small limestone boulders and medium cobbles. There was no cobble fill. Wall A47:5 was 3.1 m long, 0.25-1.05 m wide and 0.77-0.2 m high. Wall A47:8 is 2.26 m long, 0.2-0.45 m wide and 0.5-0.18 m high. Although Wall A47:8 and Wall A47:5 were constructed with two different techniques they curve in the same direction and appear to form a single structure with the walls separated by a doorway. Mud plaster surfaces (A47:22; A47:23) were located on each side of and sealed to both Wall A47:5 and Wall A47:8 at equivalent levels. Although the mud plaster surfaces were located at the same stratigraphic levels, the surface on the interior of the structure is slightly lower than the exterior surface. Therefore, the structure at this phase of occupation was semi-subterranean and circular, a structural phase common to all phases of the Neolithic, but less substantial than later PPNB Beidha. The initial building phase of the structure was not uncovered during the only season of excavation.



Figure 2.12. WT-40 Square A47 (Foley et al. 2004). Used with permission.

2.5.3. Site 40-Square 54 (Figure 2.13)

Square A54 also contains the remains of a circular structure. Two walls were identified, wall A54:5 and wall A54:11. Wall A54:5 was curved, at least 15 cobbles long, 2-4 courses high, 1 course wide, and extends into the north and south baulks. It was constructed of unfaced limestone cobbles and a mud mortar. The final measurements for the season were 5.75 m long, 0.25 m-0.35 m wide and 0.41 m-0.72 m high. Wall A54:11 runs parallel to wall A54:5 along the inside curve with approximately 0.45 m between them. There were four large, unfaced limestone boulders in a row, which continue into square A53, along with wall A54:5. The final measurements within square A54 for wall A54:11 were 5 m long, 0.23 m-0.41 m wide and 0.2 m-0.71 m high.

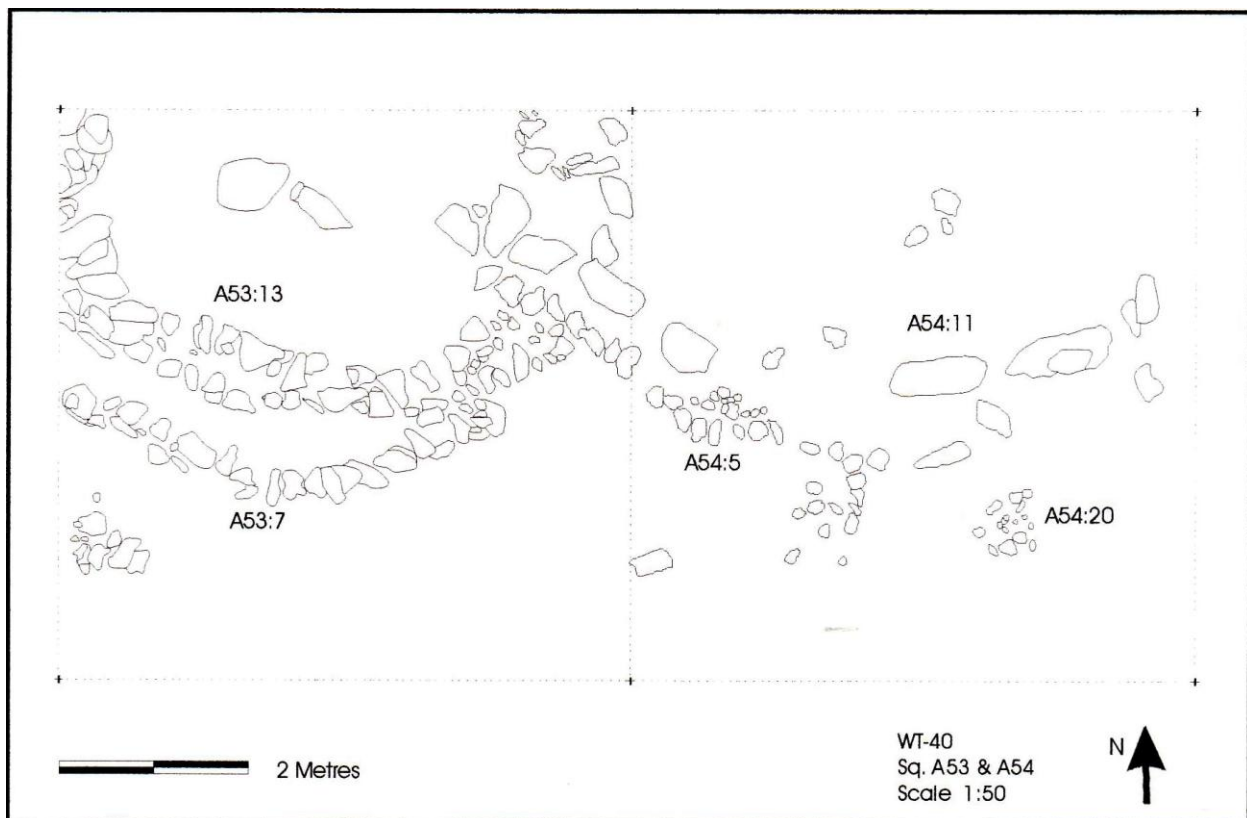


Figure 2.13. Plan of structures in Square A53 and A54 (Foley 2004). Used with permission.

Two mud plaster surfaces were identified in Square 54, A54:22 and A54:23. A54:22 was located along the inside of the curve of and sealed to wall A54:11. A54:23 was sealed to wall

A54:5 along the outside of the curve. Mud plaster surface A54:22 was at a lower depth than A54:23. The two walls appear to have originally formed a single structure. The loci between the walls was composed of a sandy, silty soil matrix with pebbles, which could be the remains of rubble fill. Two rows of stones with a rubble fill was a reoccurring method of construction at Wadi ath-Thamad, the same type of construction was used for wall A47:5, and at other sites such as Beidha, 'Ain Ghazal, Jebel Abu Thawwab, and Yiftahel.

2.5.4. Site 40-Square 53 (Figure 2.13. and Figure 2.14.)

Square 54 and Square 53 are adjacent. The structure identified in Square 54 continues into Square 53. Wall A54:11 and Wall A54:5 which have been previously described above continue into Square 53. The continuation of wall A54:11 is 2.35 m long, 0.41 m-0.68 m wide, and 0.37 m high, 1 row and 1-2 courses high. Wall A54:5 continues another 2.2 m into Square 53 and was 0.25 m-0.4 m wide and 0.47 m high. As mentioned previously, the two walls were likely a single wall for a circular dwelling, approximately 3-4 m in diameter.

Square 53 (Figure 2.14) was dominated by two large curved walls, A53:7 and A53:13. Wall A53:7 was unfaced cobbles and small limestone boulders constructed in the boulder and



Figure 2.14. WT-40 Square 53 (Foley et al. 2004). Used with permission.

chink method. It was 1 row and 1-5 courses high, 4.6 m long, 0.35 m-0.52 m wide, and 0.49 m-0.63 m high. It abuts wall A53:13, the most substantial wall uncovered at Site 40. As with the other walls at Site 40 it was unfaced cobbles, small and medium limestone boulders. The wall was 1-2 rows, 3-4 courses high, 5.4 m long, 0.5 m-1.25 m wide, and 0.25 m-0.73 m high.

As with the other curved walls on the site, mud plaster surfaces were uncovered on both sides of the walls. At least two fragmented surfaces were identified within the inside curve of wall A53:13. A53:19 consisted of two levels of mud plaster surface and A53:28, a mud plaster surface that may be on top of flat-lying stones, was identified as the possible building surface for wall A53:13. A53:28 was uncovered at the end of the season, so it was unknown if the base of wall A53:13 was connected to surface A53:28. The fragmentary mud plaster surface outside of the structure was located outside of wall A53:7. The wall that abuts wall A53:13. The surface, A53:17 outside the wall was higher than the lowest surface, A53:28, but approximately even with surface A53:19. Locus A53:17 was the final locus excavated in this section of the square. As virgin soil was not reached, it is unknown if it is the final surface.

There was another mud plaster surface, A53:29, located in between wall A53:7 and wall A53:13. Wall A53:7 curves in the same direction as wall A53:13, but is not parallel. Due to the surface in between the walls and this alignment of the wall, the excavators interpreted wall A53:7 as an earlier phase of construction (Foley et al. 2004). Wall A53:13, constructed later, cuts through the remains of wall A53:7.

Wall A53:13 and the two walls A54:5 and A54:11 appear to form a complex structure of two circular or oval rooms. The only similar single structure was one excavated by Kenyon at Jericho (Kenyon 1981: Fig. 227c, Pls. 277, 278a as cited in Garfinkel and Ben-Shlomo 2002b:73). Another structure type that may be similar to the Wadi ath-Thamad structure can be found among the Phase A and B buildings at Beidha. In Phase A, buildings 54 and 55 were both oval structures abutting one another (Byrd 2005:42-43) and in Phase B, building 25 is a subrectangular building abutting an oval structure, building 60 (Byrd 2005:47-48).

2.6. Architecture in the PN: Use

The three general categories of architecture, domestic, nondomestic, and storage were all represented in the PN, but in limited quantities in comparison to the PPN. Some sites do not even have architecture, but the people at these sites must have performed the same domestic activities, such as food preparation. With the limited or lack of architecture, the identification of what is usually the most common architectural type, domestic, is difficult. The large number of pits at the majority of PN sites are often classified as storage. There is one building at 'Ain Ghazal that has been identified as nondomestic (Rollefson et al. 1992).

The only nondomestic building identified at 'Ain Ghazal was the apsidal building. It reused a LPPNB plaster floor and the only ceramics associated with the structure were fineware (Rollefson et al. 1992). As only fineware was associated with the apsidal building it is assumed that the structure had a special purpose. Although that purpose is unknown, it is assumed it was not a common domestic structure. At Sha`ar Hagolan the buildings are all identified as domestic, but included within the domestic structures were storage areas, the paved rooms within the courtyard houses (Garfinkel and Ben-Shlomo 2002a). The excavated storage pits at Jebel Abu Thawwab revealed pottery, lithic tools and floral remains (Kafafi 1985b:126). Since pits are a common feature at PN sites, it is likely that storage or disposal was an important necessity during the PN.

Domestic structures vary in size and shape throughout the PN. Many sites have large open areas associated with the structures. Stone-wall enclosures were uncovered at 'Ain Ghazal (Rollefson 1993) and Abu Thawwab (Kafafi 1985a). Post holes associated with a stone wall at Abu Thawwab were interpreted as tent poles (Kafafi 1993). At Sha`ar Hagolan the open areas were courtyards and domestic activities, such as food preparation and consumption, were performed there (Garfinkel and Ben-Shlomo 2002a). Domestic activities were likely performed in open areas during the PN, but the areas could also have been used for tents or for the penning of animals.

Unlike the PPN, where domestic housing was identifiable and fairly uniform within and between sites, there is no consistency within the PN. In the PPN, time, energy and pre-planning were involved in the construction and maintenance of domestic structures. In the PN, the construction of domestic structures was no longer treated with the same attention as in the PPN. Time and energy appears to have been put into other activities, such as ceramic production and subsistence efforts, as evidenced by the terrace walls at Dhra` (Kuijt et al. 2007). It is also possible that sites or parts of the sites may have been used as seasonal camps by pastoral populations, negating the need for permanent structures (Rollefson 1989:136). The purpose of the domestic structure appears to have changed in some form, from an important structure that was well cared for, to what often appears to be a hastily constructed afterthought, with no typical form or construction method.

2.7. Discussion

The problem with the PN is that there is very little consistency in structures from various sites across the southern Levant. The Yarmoukian sites have free standing architecture, in a variety of sizes; courtyard buildings at Sha`ar Hagolan (Garfinkel and Ben-Shlomo 2002b); rectangular and apsidal structures at 'Ain Ghazal (Kafafi 1993; Rollefson et al. 1992); rectangular, apsidal and round structures at Jebel Abu Thawwab (Kafafi 1985a;1986;1988); and round structures at Munhata (Garfinkel 1993). The Jericho IX sites have yielded very little free standing architecture. Dhra` has rectangular structures (Kuijt et al. 2007) and Lod has circular structures (Gopher 1995). The other Jericho IX sites have no discernible structures: Wadi Shu`eib (Kafafi 1993); Nizzanim and Givat Haparsa (Gopher and Gophna 1993). Or the structures that have been recovered were pit dwellings, as at Jericho (Kenyon 1985) and Dhra` (Kuijt et al. 2007).

Wadi ath-Thamad Site 40 is not precisely analogous to any of the other PN sites, but follows a similar pattern of variable architectural elements within the PN. Circular structures have been uncovered at other PN sites, but so have rectangular and apsidal structures. The double wall method of construction is used at a variety of sites throughout the PPN and PN of the

Levant, as is the semi-subterranean structure, the use of unfaced, natural stones and the mud plaster surfaces. All of the Yarmoukian sites have free-standing structures whereas free-standing structures are only found at some of the Jericho IX sites. But the limited sample of sites and the limited excavation at the latter sites restricts our ability to generalise defining characteristics of Jericho IX architecture.

The architecture of the PN is varied, both between and within the Yarmoukian and the Jericho IX sites and at Wadi ath-Thamad, which is classified as neither. The PPNB architecture of the Levant had some defining characteristics, such as heavily plastered floors and walls, the diminishing use of wood, and well-built, well-maintained structures. In the PPNB, the pier house became the common architectural form (Byrd and Banning 1988). By the LPPNB and PPNC, corridor buildings and multi-cellular buildings within larger settlements became common (Kuijt 2000). The architectural forms of the PN ranged from pit dwellings, to round, rectangular, and apsidal buildings, to courtyard buildings. Neither the Yarmoukian or Jericho IX cultures exhibited a diagnostic architectural form.

“People recognize an association between particular groups and particular sites, as between house and household, the [architectural] structure of the one providing an analogue to the structure of the other (Wilson 1988:60). The consistent, well-built architecture of the PPNB is indicative of stable communities, which likely shared similar economic societies and possibly similar social structures. By the PN, there was little to no architectural consistency within and between sites. Perhaps this is indicative of unstable socio-cultural conditions within PN communities. If “architecture is a materialization of structure” (Wilson 1988:61), then the structure of the PN communities varied between sites or was lacking. Some of the PN sites had either little to no architecture or the inhabitants appeared to live in pit dwellings. This is contrasted to the cohesive, stable structure of the PPN that the architecture of that time period reflects. The change in the architecture from the PPN to the PN is dramatic and is reflective of the change from one period to the next.

Chapter 3: A Global Climatic Event

3.1. 8.2 ka Cold Event

Prior to the PN, the archaeological assemblages at PPN sites demonstrated a consistent socio-economic growth, both within individual sites and across the PPNB as a whole. In contrast, the variation in architectural form of the PN, pit dwellings, round, rectangular, and apsidal buildings, and courtyard buildings, does not indicate an organised and unified organisational structure of the PN population. The Neolithic settlements of the Levant were primarily sedentary agricultural communities, some of which were continuously occupied for two thousand years. Ongoing exploitation of the catchment area, combined with human mismanagement, could have exhausted the natural resources surrounding a settlement, but settlements all over the Southern Levant were abandoned at the end of the PPNB. The causes responsible for the architectural variations and site abandonments are no doubt varied, but a climate event that occurred across the globe would have affected the marginal environments of the Near East may be a partial explanation. Within the warm moist climate of the PPN is a short cool dry episode, the 8.2 ka Cold Event, which corresponds with the collapse of the PPNB (Bar-Yosef 2002:122). The 8.2 ka Cold Event is a globally recognised cooling event that began in North America with the draining of glacial Lake Agassiz. The Cold Event has been identified in Greenland ice cores, marine cores from the Mediterranean and Adriatic Seas and terrestrial cores from Greece, Turkey, Syria, Iran, and Israel.

The history of glacial Lake Agassiz and its effect on the environment has been and continues to be studied by many researchers. The prehistoric lake was named after a 19th century Swiss geologist (Perkins 2002:284). Lake Agassiz has a 5000-cal-year history that began with the retreating of the Laurentide Ice Sheet (LIS), which covered most of Canada and some of the United States. The LIS retreated into the Arctic Ocean and Hudson Bay basins and Lake Agassiz formed between the ice and the land (Teller et al. 2005:1890). At its height the LIS was almost 5 km thick, depressing the earth by over 1 km. The formation of the lake began 18 to 20 thousand years ago, as meltwater pooled in front of the retreating glacier (Perkins 2002:283-284). The size of the lake (depth, volume, and configuration) changed constantly because of isostatic rebound,

the retreating of the glacier, the topography, and the varying outlets for water. Lake Agassiz covered an average of 150,000 square kilometres at a time (Teller et al. 2002:880).

The freshwater from Lake Agassiz either overflowed or found various outlets into oceans or the Gulf of Mexico. There were five main drainage outlets until a sixth and final release of meltwater (Figure 3.1). The drainage routes are the Mackenzie Valley to the Arctic Ocean, the Mississippi River Valley to the Gulf of Mexico, three routes to the North Atlantic through the St Lawrence Valley, and through the Hudson Strait to the Labrador Sea then to the North Atlantic Ocean (Teller et al. 2005:1891). Researchers have discovered at least ten different outbursts of water through these drainage routes, each associated with a different lake stage. It has been estimated that the emptying of meltwater into the oceans took place in a short time, months to a few years (Teller et al. 2002:881). The introduction of freshwater to the ocean over a short amount of time could have had an effect on the global climate by destabilising the thermohaline circulation (THC) of the ocean system.

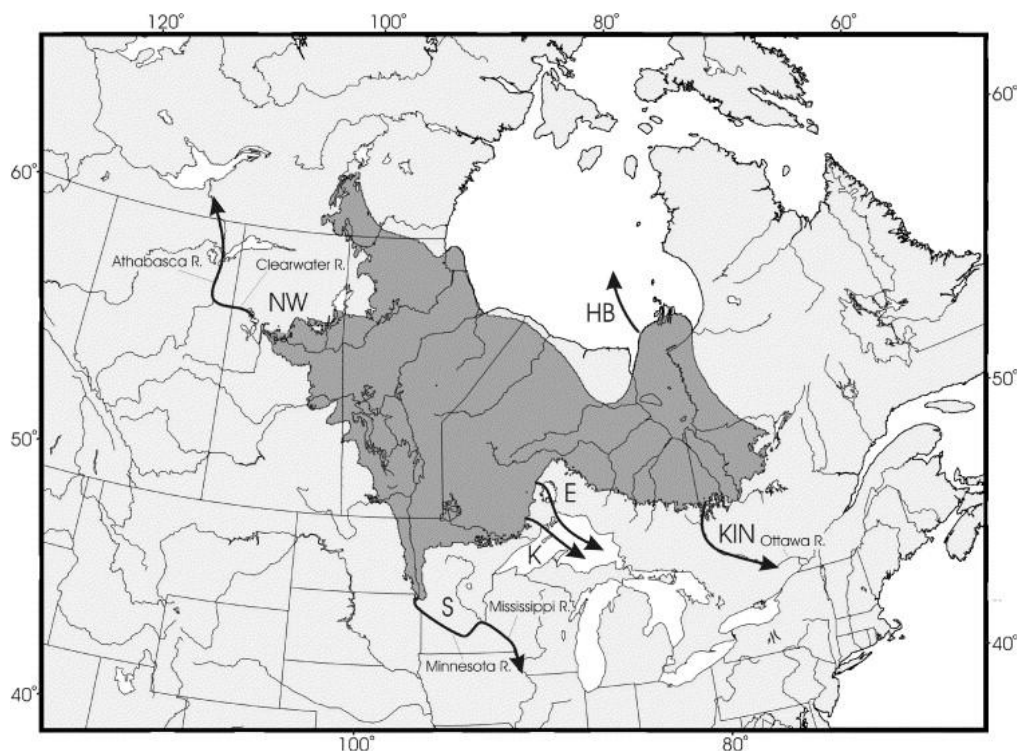


Figure 3.1. Lake Agassiz and the Main Routes of Overflow (Teller et al. 2005:1891). Reprinted with permission.

About 13,000 years ago, Lake Agassiz emptied 9,500 cubic kilometres, a 100 m drop in its lake level, of freshwater into the North Atlantic. This outburst coincided with the beginning of the Younger Dryas, a 1,600 year global cold spell (Perkins 2002:284-285). Experiments have shown that the introduction of even a moderate amount of freshwater into the North Atlantic over a short amount of time could reduce the THC and drop the surface temperature of the ocean by 6°C in less than one hundred years (Magny and Begeot 2004:186). The Younger Dryas was a colder and drier period than the previous thousand years which affected populations all over the world (Weiss 2000:75). Lake cores from southern Sweden demonstrate this quickly cooling climate (Fagan 2004:91).

The Preboreal Oscillation, a cool period that lasted for about two hundred years, followed the Younger Dryas. It has been theorised that this climate change can be attributed to a freshwater outburst into the Nordic Sea or the draining of the Baltic Ice Lake, which reduced the THC (Teller et al. 2002:885). Two drainage events associated with Lake Agassiz also proceeded the Preboreal Oscillation, one of 9,300 cubic kilometres and one of 5,900 (Teller et al. 2002:879). The Preboreal Oscillation is a short climatic event, but it made enough of an impact on the geological record to be observed.

The final outburst of glacial Lake Agassiz was the largest known outburst of the last 100,000 years. By this time, Lake Agassiz had become a superlake, with approximately 163,000 cubic kilometres of freshwater (Clarke et al. 2003:922). Agassiz had merged with Lake Ojibway, to cover 841,000 square kilometres. The amount of water in superlake Agassiz was about 30% more than the total amount of water in all of today's lakes (Perkins 2002:286-287). About 8.4 ka years ago, the glacier dam holding back the water broke and released the 163,000 cubic kilometres of water through Hudson Bay and into the North Atlantic. There is debate about whether or not the water was released as a single event or as multiple events, and the length of time it took to drain (Clarke et al. 2003:923; Teller et al. 2002:881). However, the water was released. The release of so much freshwater into the North Atlantic began the 8.2 ka cold event (a 300-400 year mini ice age) that has been observed all over the globe.

The Greenland Ice Sheet Project II (GISP2) and the North Greenland Ice Core Project (NGRIP) involved both the drilling and study of ice cores with the goal of identifying climatic disruption. Greenland ice-core records can provide “information on long-term (millennial, supramillennial) and short-term (submillennial to annual or seasonal) cycles or trends in the Earth’s past environmental history” (Johnsen et al. 2001:300). As snow accumulated annually and was converted to ice, the temperature of the cloud vapour and to some extent the air temperature can be determined by studying the stable oxygen isotope ratios ($\delta^{18}\text{O}/\delta^{16}\text{O}$) in the ice (Johnsen et al. 2001:300).

The 8.2 ka cold event is the only rapid cooling event identified in the Greenland ice cores (Figure 3.2). The ice-core records can be accurate to the absolute year (Johnsen et al. 2001:300). The cold event was absolutely dated to 8170 yr. B.P. (Johnsen et al. 2001:302). A 200-yr-long $\delta^{18}\text{O}$ decrease was recorded, indicating a temperature decrease of $4\pm 2^\circ\text{C}$ during a few decades (Masson-Delmotte et al. 2005:941). The 8.2 ka cold event pattern in the ice core is described as “cold, dry, dusty, and low methane occurring together” (Alley et al. 1997:484). Mediterranean pollen data indicate a 10-15% decrease in the percentage of temperate pollen during the same time frame (Masson-Delmotte et al. 2005:941). Forest-fire frequency was also determined by detecting the fire-produced ammonium, for which an increase of 90% occurred during the 8.2 ka event (Alley et al. 1997:484).

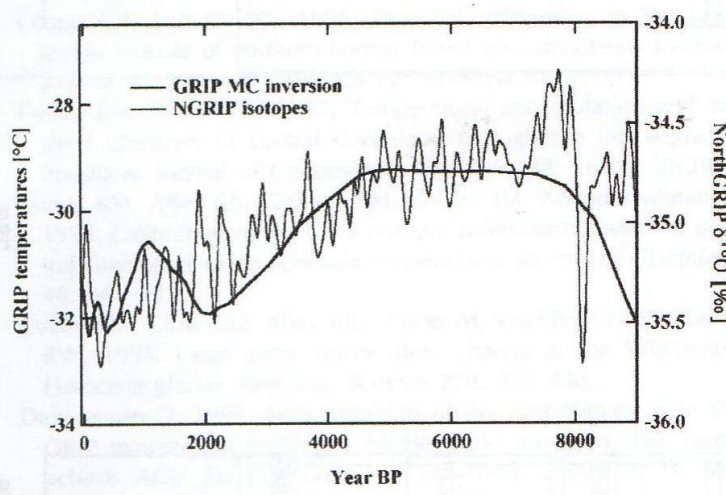


Figure 3.2. The NorthGRIP $\delta^{18}\text{O}$ record with Cold Event spike (Johnsen et al. 2001:305). Reprinted with permission.

The brief cooling period has also been identified by Rossignol-Strick (1999) in the context of a comparative study of marine cores from the Mediterranean and Adriatic Seas and terrestrial cores from Greece, Turkey, Syria, Iran, and Israel. A sharp decrease in *Quercus* and *Pistacia* pollen was observed in land records and a 200 yr. break in sapropel development in the Adriatic Sea cores dated to approximately 8000 – 7600 year ago (Rossignol-Strick 1999:526). Sapropel is an organic-rich sediment, formed when an increase of organic matter is preserved in the bottom sediment of the sea floor (Rosen 2007:75)

The LC21 marine core (Figure 3.3), taken from the Aegean Sea to the east of Crete, was analysed using a simple grouping of warm or cold faunal categories. “The warm species are

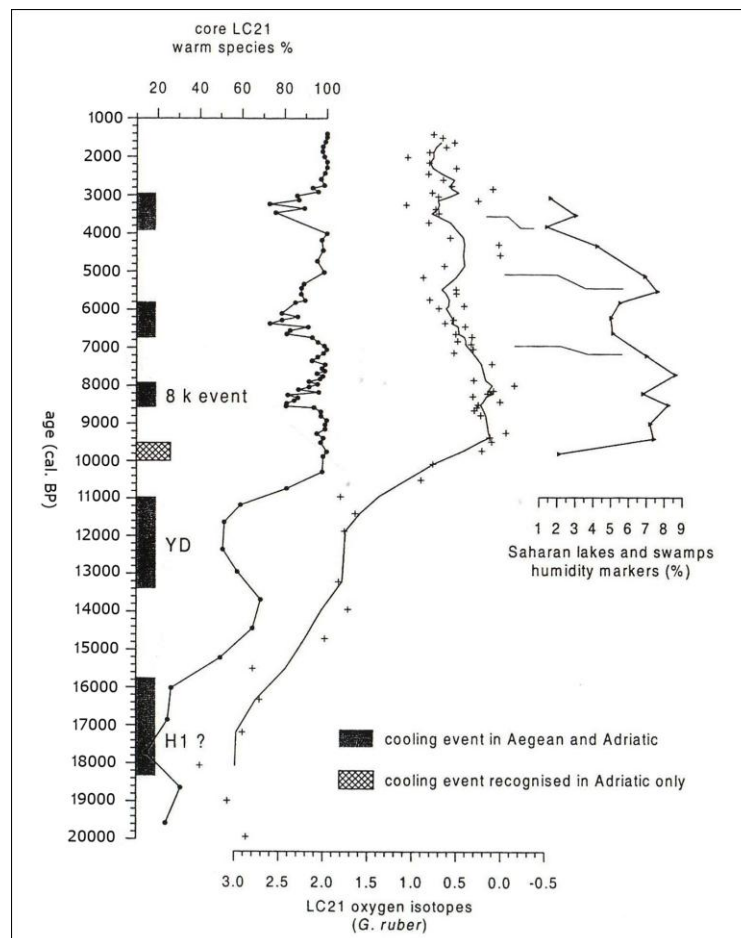


Figure 3.3. Warm-cold Record and Stable Oxygen Isotope Record for the LC21 Core (Rohling et al. 2002:41). Reprinted with permission.

those that dominate in subtropical waters of the present-day ocean” (Rohling et al. 2002:40). There is a drop in the percentage of warm species that coincides with the 8.2 ka Cold event (Figure 3.3). A lowering of the SST (sea surface temperature) is associated with a drop in the percentage of warm species and with cooling events (Rohling et al. 2002:40). The SST record of LC21 identified a possible temperature drop of 2°C, in a very short amount of time (less than 50yrs), coinciding with the 8.2 ka Cold Event (Rohling et al. 2002:44).

The draining of superlake Agassiz into the ocean and subsequent 8.2 ka Cold Event affected global temperatures and environmental conditions (Figure 3.4). Evidence for the changes in temperature and environmental conditions has been found in Greenland ice cores, marine and terrestrial cores, pollen data, changes in sapropel data, and a drop in sea surface temperature. The variety of evidence specifies a sudden and rapid event that only lasted for a few hundred years, but was severe enough to be detected in a diverse set of data.

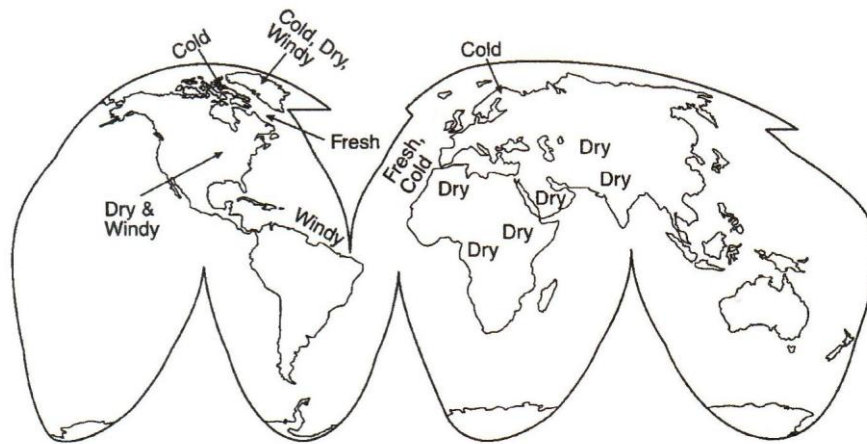


Figure 3.4. Environmental Conditions Associated with the 8.2 ka Cold Event (Alley et al. 1997:485). Reprinted with permission.

3.2. Near East Regional Evidence for the 8.2ka Cold Event

The 8.2 ka cold event is observed in the Near East, but the data are not as yet specifically related to archaeological sites. In Israel, the primary data identifying the 8.2 ka cold event come from the study of speleothems in the Soreq cave, Israel (Bar-Matthews et al. 1999). But there are

also pollen studies, stable oxygen isotope records, and geomorphological evidence from different areas of the Near East that identify disruptions coinciding with the 8.2 ka event.

The Soreq cave is located in central Israel, approximately 40 km inland from the Mediterranean Sea. The researchers performed high resolution analyses of the oxygen and carbon isotope ratios in speleothem growth layers to determine climatic variations over the past 60,000 years (Bar-Matthews et al. 1999:86). Speleothems are secondary mineral deposits, formed “from calcite deposits that precipitate out of water dripping from walls and ceilings” (Rosen 2007:27). Because of the semi-arid climate of Israel, speleothems grew continuously through glacial and interglacial periods, retaining evidence of any climate variations over that time frame (Bar-Matthews and Ayalon 2004:364). Oxygen and carbon isotope ratios were analysed in the speleothems layers to determine average annual temperature and rainfall amount. The analysis from the Soreq cave has provided 60,000 years of records (Bar-Matthews et al. 1999:86). From 8.5 kyr to 7 kyr heavy rainfall was identified in the area, except for a sharp cooling and drop in rainfall amounts at 8.2 kyr (Bar-Matthews and Ayalon 2004:384).

In the Negev Desert, an arid phase has been identified by an absence of sediment deposits which may be associated with the 8.2 ka cold event (Rosen 2007:79). A study of the Holocene environments in the Wadi Faynan, Jordan, identified desiccation through pollen assemblages coinciding with the global event (Hunt et al. 2004:927). Wadi Faynan is located in southern Jordan in the rift margin. Pollen assemblages indicate the vegetation was likely from a steppe environment before 8 ka, then between 8 and 7.4 ka pollen counts and rainfall estimates decline (Hunt et al. 2004:927).

Pollen analysis has been useful in studying Holocene vegetation patterns in the Near East. In particular three pollen profiles have been studied from Söğütlü in Turkey, Lake Hula in the Jordan Valley, and the Ghab Valley in Syria (Wilkinson 2003). Interpretations of these pollen profiles vary, particularly in regard to the radiocarbon dates (Rosen 2007). Therefore, the observations presented here will be generalised. Rossignol-Strick (1999) identified a sudden drop in deciduous trees and *Pistacia* pollen in the Ghab Valley core. When summarising the climate in the Mediterranean region Rossignol-Strick (1993) identifies a drop in precipitation during the

summers and a drop in winter temperatures for approximately 200 years, which may coincide with the 8.2 ka event.

A humidity curve from Lake Van, located in eastern Turkey, shows low humidity beginning at approximately the same time as the 8.2 ka event. The analysis of tree pollen from the same study of Lake Van show “a low percentage of tree pollen...and a high percentage of non-arboreal pollen, indicating dry conditions” also coinciding with the 8.2 ka event (Issar and Zohar 2007:68). Core samples from the Persian Gulf also indicate a humid climate interrupted by a brief dry climate during the period discussed (Issar and Zohar 2007:69).

Overexploitation of a sites catchment area, and in particular deforestation, is the current explanation for the abandonment of PPN sites (Köhler-Rollefson and Rollefson 1990). Interpretations of pollen diagrams do not show evidence for large scale deforestation until approximately 4000 years ago (Wilkinson 2003:27). It is possible that deforestation still occurred, but only in localised areas around certain settlements. Or one could suggest that the pollen sequences have not been taken from areas close enough to settled populations.

There are no studies directly linking the 8.2 ka cold event with any Southern Levantine sites, but there is indirect evidence such as the colluvial deposits at Wadi ath-Thamad (Cordova et al. 2005). The timing of the global event coincides with the end of the PPNB and the PPNC. “It is well-known that correlation does not mean causation. However, when major changes in both the natural world and the human sphere seem to have occurred at the same time, further investigations for possible causal relationships is called for” (Bar-Yosef 2001:133). Although this thesis focuses on the Southern Levantine sites, the PPNB is observed in the Northern Levant and Anatolia (modern Turkey and Syria), as is the cultural gap and shift in settlement patterns that mark the end of the PPNB (Bar-Yosef 2001:150). Such a disruption of the PPNB across so large an area, encompassing a variety of ecological zones, could be explained by a global event, such as the 8.2 ka cold event.

Although there is no direct evidence linking the 8.2 ka cold event and Southern Levantine sites, the environmental conditions of the region did change from the PPN to the PN.

Paleoenvironmental data is slowly being accumulated for the Levant, both in conjunction with archaeological excavations and on their own. The change in environmental conditions would have had an effect on the population. Some of the data that are currently available will be examined in the following chapter.

Chapter 4: Near East Environmental Conditions and the 8.2 ka Event

4.1. Pre-Pottery Neolithic Environmental Considerations

The PPN witnessed a return to humid, warmer climatic conditions from the cool, dry conditions that characterised the end of the previous Natufian Period (Rosen 2007:36-37). The early Holocene witnessed two unusually wet periods, at approximately 6400 B.C. and 5600 B.C., with a cool dry phase (8.2 ka event) in-between at 6200 B.C. (Rosen 2007:98-99). A wide variety of data has been accumulated to study the paleoenvironment of the Levant: isotope data, pollen evidence, lake-level data and geomorphological evidence (Rosen 2007:97). These regional and local data coincide with the global data identifying the 8.2 ka Cold Event. The timing of the 8.2 ka event corresponds with the LPPNB and the PPNC (Rosen 2007:37), and likely leads to the collapse of the PPNB in the Levant (Bar-Yosef 2002:122).

The PPN began as the Younger Dryas, a 1600 year global cold dry spell, ended. Evidence from soil development, landscape stability, and perennial streams indicate increased rainfall, distributed year-round in the PPN (Rosen 2007:80). Rossignol-Strick (1993) identifies the warm moist period associated with the PPN as the *Pistacia* phase, on the basis of the increase of *Pistacia* and *Quercus* (oak) pollen (Rosen 2007:75). The climate following the Younger Dryas has been interpreted as having no summer drought, temperate winters and 800 to 1300 mm of precipitation a year (Rosen 2007:75, Rossignol-Strick 1993:150).

The improved climate of the PPN is apparent in the deposition processes at Wadi ath-Thamad. (Cordova et al. 2005:48). The Thamad III depositional unit of fine silt and gravel beds is indicative of moister climatic conditions. The silt deposits separating the Natufian and the PPNB occupational surfaces may have been put down by floodwaters (Cordova et al. 2005:48). Cordova et al. (2005) interpret the increased soil erosion at Wadi ath-Thamad as evidence of an extended moister climate. Overall, the warmer climate combined with a continuous and increased rainfall provided a reasonably reliable environment for agricultural societies (Rosen 2007:97).

At Wadi ath-Thamad the stratigraphy of WT-40 is composed of three layers: a surface of fine-grained aeolian sediment lightly covering gravel, a significant colluvial deposit of “hard-packed, grey, water-washed sediment containing fist-sized and slightly larger cobbles and small boulders”, and finally a layer of loose fine-grained sediment (Foley et al. 2004:11). Within the Thamad II deposition, silt accumulation changes abruptly to a colluvial deposition of angular and subangular gravel, which is attributed to a climate change, the Younger Dryas, namely the cold, dry episode at the end of the Pleistocene (Cordova et al. 2005:48). Colluvial deposits increased when erosion caused by anthropogenic or environmental factors reduced soil cover. The colluvial deposit observed during the excavation of WT-40 and in places on the terrace surface, described as “a substantial layer of hard packed, grey, water-washed sediment containing fist-sized and slightly larger cobbles and small boulders... in fan-like flows” may also be indicative of a brief climatic episode, similar to the Younger Dryas (Foley et al. 2004:11). Although the 8.2 ka event only lasted a fraction of the time, it was similar to the Younger Dryas and could have caused the same changes in the colluvial record.

In summary, the following pattern emerges. For the most part, the environment of the PPN in the Southern Levant was warm with year-round rainfall (Rosen 2007:80). These were ideal conditions for the growth of agricultural communities. Within the Neolithic, two wet periods were identified at approximately 6400 B.C. in the PPN and 5600 B.C. in the PN, with a cool dry episode in-between them at 6200 B.C., known as the 8.2 ka cold event (Rosen 2007:97-99). The cool dry episode coincides with the LPPNB and PPNC, when many sites within the Levant and Anatolia were deserted or experienced a gap in occupation (Bar-Yosef 2001:150). The PPN ended with fluctuating rainfall, between moist and dry conditions (Rosen 2007:99).

4.2. Pottery Neolithic Environmental Conditions

The fluctuation between moist and dry conditions that coincided with the end of the PPN continued into the PN (Rosen 2007:99). As with many aspects of the PN, the available data on the environment and climate are limited. There is some pollen evidence indicating an increase in olive pollen, but there may have been deforestation in some areas (Rosen 2007:84-85). The

climate began to improve around 5600 B.C., as it gradually changed to a Mediterranean climate, similar to that of today (Issar and Zohar 2007:73-75). Overall, the PN appears to have begun with fluctuating conditions, before stabilising to a warm moist climate. A Mediterranean environment tends to receive approximately 350 mm to 1200 mm of precipitation annually (Henry 1989:63). The bulk of the precipitation falls in the cooler winter months, refilling the water table and feeding springs that continue to flow in the dry summer months. There is little to no precipitation through the summer months (Issar and Zohar 2007:75). The Mediterranean climate has distinct seasonal differences, but overall moderate temperatures (Henry 1989:61).

The pollen diagrams from Lake Hula indicate the first increase in olive pollen for the area (Baruch and Bottema 1999). The detection of olive in the pollen diagram reflect warmer winter temperatures, as warmer temperatures are necessary for olive cultivation (Baruch and Bottema 1999:82). The evidence from the Hula pollen diagram indicates the cultivation of the olive, not just the foraging of the wild olive (Baruch and Bottema 1999:82). Pollen studies have also been performed on cores from Lake Ghab, in northwest Syria Rift Valley (Rosen 2007:50). A decrease of pine and cedar, along with an increase of evergreen oak in the higher elevations at Ghab are interpreted as evidence for deforestation. The evidence for deforestation in the northern Levant may correspond with evidence in the south of colluvial deposits during the PN, indicating an increase in precipitation (Rosen 2007:85).

The return to a wet humid climate implies a corresponding increase in arboreal vegetation. Within the PN, there is little evidence for the return of forest cover. There could have been a number of reasons for the lack of forest cover in the PN. One reason could be related to the Mediterranean climate, which may have encouraged grasses and shrubs to grow instead of deciduous oaks (Fall et al. 2004:144). Another explanation for a lack of forest growth could have been an increased need for grazing land (Hunt et al. 2004:929). Soil erosion and colluvial deposits have been observed at several PN sites, such as 'Ain Ghazal (Mandel and Simmons 1988), Jericho (Bar-Yosef 1986), Wadi Shu'eib (Simmons et al. 2001) and Wadi ath-Thamad (Cordova et al. 2005). The soil erosion and colluvial deposits may have contributed to the lack of forest growth as well. The change of climate combined with some human interference in the

form of deforestation and the grazing of animals may also account for colluvial deposits at PN sites (Rosen 2007:80).

The available information for the PN environment is limited. This is partially due to the short time span of the PN. At the beginning of the PN the climate fluctuated between wet and dry conditions (Rosen 2007:99). Throughout the PN, a typical Mediterranean climate of dry summers and cooler winters became common (Issar and Zohar 2007:75). The first increase in olive pollen was detected, along with deforestation and increased colluvial deposits, indicating wetter conditions and possible human interference (Baruch and Bottema 1999; Rosen 2007).

Chapter 5: Adaptive Strategies

Environmental studies and archaeological excavations tend to be separate disciplines, but modern archaeological excavations often involve some form of geomorphological study of the surrounding area. Unfortunately, the environmental studies associated with archaeological sites are often brief and limited to one or two paragraphs in an archaeological report. Therefore, studying the impact of a global climatic event on specific archaeological sites must utilise the material culture left behind.

The climate of the PPN was particularly suited to the agricultural based settlements found in the Southern Levant. Soil rich in organic materials and predictable annual rainfall contributed to the success of PPN settlements (Rosen 2007:97). Since the inhabitants of the PPN settlements could rely on a steady food source, their communities flourished. As previously discussed, one of the defining characteristics of the PPNB settlements in the Southern Levant was the development in architectural techniques. The time, energy and skill required to build the consistent, well-built architecture found at PPNB sites would not have been available if the communities were struggling to meet their basic needs.

The 8.2 ka event triggered a 300 – 400 year cold phase, which coincides with the abandonment of many PPNB sites. Following the PPNB, the few PPNC sites and then the PN sites no longer give the impression of cohesive communities, on a local or regional level. There are exceptions. For example, Sha`ar Hagolan exhibits signs of organisation and planning. However, the architecture, if there is any, at PN sites is a mixture of styles at site and regional levels. The abandonment of so many PPNB sites meant the inhabitants of those sites had to resettle in new communities. Perhaps with the uncertainty of resettlement, caused by a disruption in the climate patterns, along with members of different communities forming new settlements the architecture lost its cohesive pattern observed in the PPNB. If the inhabitants were unsure of the permanent nature of a new settlement they may not have devoted much time and energy to their new living quarters, and instead focused on subsistence.

As the PPN came to an end the subsistence base of the Levantine population had already begun to change. The introduction of goat expanded the subsistence base, but increased the stress on the catchment areas surrounding PPN settlements. During the PPN, the settlements all had the same subsistence base and their architecture followed similar plans. By the PN, the architecture in settlements no longer conformed to a set plan and they now had varying subsistence bases. The settlements during the PN appear to have used different adaptive strategies to cope with the disruption of the PPN economic systems.

During the earlier Natufian phase of occupation in the Levant a similar situation of environmental change and differing adaptive responses occurred. About 11,000 years ago arid conditions changed the Mediterranean woodland distribution, thereby disrupting the availability of storable resources (Henry 1989:29). Early Natufians evolved from simple foragers to complex sedentary foragers, leaving themselves “particularly susceptible to the kinds of destabilizing forces represented by the onset of the drier conditions” (Henry 1989:30). Henry (1989) describes two differing adaptive responses to the arid conditions. Those near reliable water sources could have cultivated cereals to supplement foraging and those without secure water sources may have returned to simple mobile foraging (Henry 1989:29).

The adoption of goat as the primary meat source in the PPN changed the subsistence strategies of the PPN inhabitants, as has already been discussed. At ‘Ain Ghazal, researchers consider the adoption of domesticated goat a response to increased population pressure and decreased faunal resources (Köhler-Rollefson and Rollefson 1990:11-12). The increase in population observed at ‘Ain Ghazal began prior to the 8.2 ka event, but continued at an increased rate after the cold event began before slowly diminishing through the final occupation period (Köhler-Rollefson and Rollefson 1990:7-8). Determining population size is very difficult for a prehistoric community. One of the factors used to estimate population is through architectural design. In the LPPNB, the architecture at a number of sites (‘Ain Ghazal, Beidha, Basta) demonstrated a significant increase in the compartmentalisation of structures (Kuijt 2000:88). It has been argued that the increased compartmentalisation was a response to the “stress of social crowding and desire to delineate space for privacy, or growing emphasis on personal goods, or...a combination of these factors” (Kuijt 2000:89). The increase in population at these

communities was likely a combination of both internal growth and population movements due to abandonment of other sites.

The desertion of PPN sites occurred over a span of hundreds of years and it is likely many would have been abandoned had the cold event not occurred. But, the climatic event exacerbated the problems already occurring and the coping methods of some communities were better than others. The increased compartmentalisation was likely an adaptive response to sudden population increases caused by the abandonment of sites that were ill-equipped to deal with the initial effects of the cold event.

The increased compartmentalisation at 'Ain Ghazal, Beidha, and Basta was only one of the adaptive responses observed at LPPN sites. The use of lime plaster declined dramatically toward the end of the PPN, a process that required time and resources. Also, these sites all had a distinct change in faunal remains. Goat was now the dominant resource, as opposed to gazelle, indicating a change from hunting to herding. Gazelle had been the primary faunal resource in the Levant for approximately 3000 years, as far back as the Natufian period (Henry 1989:215). Increased population in the Levant had probably begun to overexploit the gazelle herds; then the cold event would have affected the animals' food sources, leading to their extinction or abandonment of the area. The sites that adopted goat as their primary faunal resource remained inhabited into the later PPN.

The adaptive responses discussed were not enough to save the PPN communities. 'Ain Ghazal and Wadi Shu'eib are the only known sites that remained inhabited from the PPNB to the PN. By the time the 300-400 yr mini ice age (the 8.2 ka cold event) came to an end the PPN was over and the PN beginning. The settlements of the PN demonstrate only minimal regional cohesion (the production of ceramics became the primary local industry) and the architectural consistency of the PPN no longer exists.

The lack of consistency in construction plans and techniques between PN sites is indicative of each site undertaking a different response to the failure of the PPN socioeconomic systems. The Jericho IX sites had minimal to no architecture. At Jericho and Dhra` it appears that

inhabitants lived in pits, as walls and floors were found in these pits (Kenyon 1985; Bennett 1980). At Dhra` other structures were found, in particular terrace walls. At Jericho the walls of the previous occupation period were visible, so the inhabitants knew how to construct above ground buildings, but chose to live in the pits. Perhaps after the instability of the end of the PPN inhabitants at these sites did not find value in focusing their energies on constructing dwellings. Ceramics were found at both sites, so some time and energy was focused on ceramic production. And the terrace walls at Dhra` indicate the group worked together to improve the possibility of successful agricultural yields.

The adaptive responses to the end of the PPN did not save 'Ain Ghazal, which remained continually inhabited from the MPPNB until it was abandoned during the Yarmoukian period. The Yarmoukian occupation devoted much less time to architectural construction. Only one structure was built in its entirety during this time, the unique apsidal structure. All other structures were originally from the previous occupation period and modified (Rollefson et al. 1992; Rollefson 1993). As with Jericho and Dhra`, the construction and maintenance of structures was no longer where inhabitants focused their energies.

The inhabitants at Jebel Abu Thawwab did expend some time and energy into the construction of structures, but the techniques and structure form had no consistency. Buildings were round, rectangular and apsidal and walls were constructed using many different techniques (Kafafi 1985a; Kafafi 1986; Kafafi 1988; Kafafi 1993). It would appear that the inhabitants constructed buildings haphazardly, using whatever methods were previously known to them or simplest at the time and whichever form was decided upon at that time. There is no evidence of pre-planning or cohesion within the community.

Sha`ar Hagolan is unique among PN sites. It is the only site with substantial architecture. At the other PN sites, both Yarmoukian and Jericho IX, architecture is limited and the pre-planning and care associated with PPNB architecture no longer exists. Structures appear to have been built quickly and in whatever form was simplest at the time. At Sha`ar Hagolan, the settlement appears to have been pre-planned, and a new type of structure which becomes common in later periods was uncovered. The courtyard house makes its first appearance here and

the settlement itself includes roads and alleyways (Garfinkel and Ben-Shlomo 2002a). Another significant structure was a well. Although Sha`ar Hagolan was located close to the River Yarmuk, the inhabitants still took the time to construct a well (Garfinkel 2004:87). Perhaps the inhabitants wanted to have an accessible and protected source of water during a climatically unstable time. Sha`ar Hagolan appears to be the only organised and unified PN settlement, but their adaptive response did not ensure the settlement's continued existence.

Although the PN sites examined in this study displayed differing adaptive responses to the end of the PPN, none of them remained inhabited into the next period, the Chalcolithic. Some sites, Jericho and Dhra`, did not take the time to construct many dwellings. At 'Ain Ghazal previous structures were adapted for new purposes. Jebel Abu Thawwab has no cohesion and Sha`ar Hagolan was a pre-planned community. The different adaptive responses observed at PN sites indicates that the PPN did not end naturally with the next occupation phase slowly evolving past the previous occupation and eventually overtaking it. The varied types of settlements associated with the PN indicates a fractured region attempting to recover from the collapse of the previous occupation period. It is likely than some of the PPN communities died a natural death, but for the entire region to have become so fractured something must have affected the region for a significant amount of time. A 300 – 400 year mini ice age (the 8.2 ka event) would have significantly impacted the entire region and made recovery a long process.

Chapter 6: Conclusion

The analysis of the PPN and PN architecture has demonstrated a distinct change from one period to the next. During the PPN, there was a clear progression in architectural technique, particularly at Beidha (Byrd 2005). In the PN, the architecture becomes a seemingly random mixture of styles and construction techniques. Neither the Yarmoukian nor the Jericho IX assemblages had a distinct architectural form or technique. Each of the PN sites examined in this study appeared to use a different adaptive strategy to cope with the changes associated with the collapse of their predecessor's culture.

The PN is defined by its lack of consistency. The demise of the PPN coincided with the 8.2 ka cold event and the PN inhabitants were left to cope with the changes in physical, economic, and social environments. The varied nature of PN settlements is an indication that different adaptive strategies were used. We can observe these through the diverse architectural techniques used in the PN. The economic strategies of the PN inhabitants changed as well, with domesticated goat becoming a primary meat source. Socioeconomics, or the social impact of economic change, can be difficult to study in a prehistoric context. With no written record available, social change can only be observed through changes in material culture. Postulating that architecture is a reflection of social structure, the inconsistent nature of PN architecture suggests a disruption of the social structure (Wilson 1988). No doubt the adaptive strategies used at different sites included changes in the social structure as well as in the physical and economic environment, further removing PN inhabitants from the previous PPN culture.

The reasons for the demise of the Pre-Pottery Neolithic and subsequent changes in architectural, settlement, and subsistence patterns remain unclear. The reigning theory for the desertion of PPN settlements is the overexploitation of surrounding catchment areas, based primarily on the evidence from 'Ain Ghazal (Köhler-Rollefson 1988; Köhler-Rollefson and Rollefson 1990; Rollefson 1996). Henry's (1989) examination of the transition from complex foraging to agriculture by the Natufian inhabitants argued that climate change was not the cause, but that the transition was caused by Natufian adaptive systems. "Had the climate not changed, it is likely that the Natufian ecosystem would have been upset by some other environmental

perturbation or from population pressure alone” (Henry 1989:40). The same situation seems to account for the cultural changes from the PPN period to the PN period.

A goal of this thesis is to add climate change to the discussion of the PPN to PN transition. I do not dispute the theory that the Neolithic inhabitants mismanaged the catchment areas around their settlements, but the end of the PPNB in the Levant was a widespread event. A global climatic event is more likely to have affected multiple sites. Although the evidence of a climatic event remains general in regard to the Near East, a disruption of the global climate could impact all four physiographic zones in the Levant. The global cooling event recognised across the globe, 8.2 ka event, coincides with the LPPNB and PPNC (Bar-Yosef 2001:150). This thesis only touches on the possible causal connection between the global climatic event and the demise of the PPN in the Near East. But with further research, this author believes the study of climatic changes in the Near East can improve our knowledge of cultural change in the Levantine Neolithic.

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